

KSC Technical Capabilities

This section showcases the Kennedy Space Center's technical capabilities for partnership opportunities. The intent of providing this information is to make prospective customers aware of our capabilities and to provide the opportunity to form relationships with our experts by [contacting them](#) directly or filling out a "[Partnership Interest Request Form](#)." We look forward to future collaboration with you and your company!

1.0 Ground Operations & Processing Services

Expertise for all aspects of spacecraft, payload, and launch vehicle processing

- Human, expendable, and reusable vehicle pre-launch assembly, integration, and testing through recovery. Includes avionics, command & control, access & handling, commodity servicing, and weather & debris monitoring. ([Read more](#))

2.0 Design & Analysis Solutions

Expertise in design (ground systems and flight interfaces) for full life cycle from concepts, prototypes, modeling & simulations, design specifications and drawings, fabrication through acceptance and sustaining.

- Mechanical, electrical, fluids, avionics, and command & control; including time-zero umbilical system development and launch induced environments. ([Read more](#))

3.0 Command and Control Systems / Services

Expertise in hardware and software development for checkout and launch of spacecraft, payload, and launch vehicles.

- System design, simulation, testing, integration, operations, maintenance, sustaining, engineering process, IT security and telemetry monitoring capability. ([Read more](#))

4.0 Materials & Processes

Expertise for materials selection, corrosion control, nondestructive evaluation, custom optics, welding engineering, contamination control, testing & analysis laboratories.

- Includes anomaly investigations and launch equipment/component qualifications. ([Read more](#))

5.0 Research & Technology Development

Expertise & partnerships in cryogenics, electrostatics, advanced materials, corrosion mitigation, advanced remote habitation service.

- Corrosion coatings, dust mitigation, specialized insulation, leak detection and isolation of hazardous commodities, water purification, oxygen production, radiation shielding, biomass production and processing. ([Read more](#))

6.0 Laboratories, Shops & Test Facilities

KSC available Shops, Laboratories and Test Facilities with a variety of equipment to satisfy the needs of research and development.

- Extensive laboratories, shops, and test facilities for on-site, rapid response test, analysis, fabrication, and research & technology development. ([Read more](#))

We will update this website, as appropriate, to inform prospective customers when new capabilities are realized as available for potential collaboration with outside customers.

KSC Technical Capabilities

1.0 Ground Operations & Processing Services

Expertise for all aspects of spacecraft, payload, and launch vehicle processing.

Human, expendable, and reusable vehicle pre-launch assembly, integration, and testing through recovery. Includes avionics, command & control, access & handling, commodity servicing, and weather & debris monitoring.

1.1 Spacecraft Processing

- Engineering expertise and multi-discipline services for human, expendable, and reusable spacecraft processing capabilities including integrated testing, servicing, launch, and recovery services. ([Read more](#))

1.2 Payload Processing

- Engineering expertise services for the launch site support of pressurized and non-pressurized payload / cargo processing, transport / handling, and integration of payloads, payload carriers, telescopes, and Space Station components including life sciences and biological. ([Read more](#))

1.3 Launch Vehicle Processing

- Engineering expertise and multi-discipline services for human and expendable launch vehicle processing operations including assembly, integration, testing, servicing, launch, and recovery of flight elements delivered to KSC. ([Read more](#))

1.4 Avionics Test & Checkout

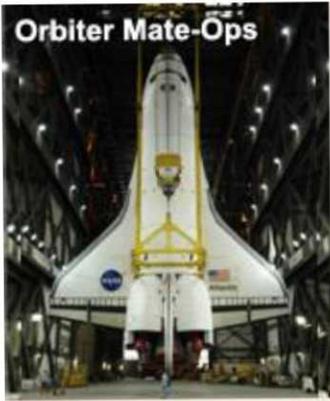
- Technical expertise in guidance, navigation, and flight control systems and engineering services for aerospace flight hardware, ground support equipment, and avionics systems. ([Read more](#))

1.5 Commodity, Handling, and Servicing

- Engineering expertise and multi-discipline services for the storage, transfer, and distribution of fluids, and gases, including the associated operations and maintenance of propellants, facilities, systems, and equipment. ([Read more](#))

1.6 Weather Technology and Radar Debris Diagnostics

- Development of weather constraints to ground operations and launch to protect personnel and flight hardware while minimizing delay and cost.
- Highly advanced radar capability to monitor vehicle dynamics, flight performance, and debris events during launch, ascent, and landing. ([Read more](#))



Orbiter Mate-Ops



**Saturn I-B
Assembly Ops**



Radar Station



**Space Shuttle
Flight Deck**



**Orbiter Helium
Servicing**



**Space Shuttle
Lightning Strike**



**Mars Lander
Processing**



**Summer Storms
Over KSC**



**Space Station
Element Processing**



Space Shuttle Launch Control Center

KSC Technical Capabilities

1.1 Spacecraft Processing

Decades of experience in the handling of delicate flight hardware

Capabilities / Services

- Expertise in assembly, processing, [transport & handling](#), integration, launch, and recovery (full life-cycle) of manned and unmanned spacecraft
 - Integrated testing for propulsion, life support, structures, electrical, instrumentation, and mechanical systems
- [Inspection and non-destructive evaluation](#) (NDE)
- Real-time anomaly resolution
- [Commodity servicing / de-servicing](#)
- Contamination control engineering
- Crew support systems
- [Life cycle modeling and simulation](#)
- Mishap investigation

Accomplishments

- Processing and launch of 132 Space Shuttle missions including tens-of-thousands of successful component replacements, detailed inspections, and flight hardware modifications
- Space telescope (optics) processing (Hubble & Chandra)
- 54 Space Shuttle orbiter transports from Edwards Air Force Base following landing

Equipment / Facilities

Facilities

- Orbiter Processing Facility
- Space Station Processing Facility
- Operations & Checkout Building
 - [Altitude chambers](#)
- Vehicle Assembly Building
- Launch Complex 39 and CCAFS Launch Complex
- Multi-Payload Processing Facility
- Shuttle Landing Facility
- Space Shuttle Main Engine Processing Facility
- Payload Hazardous Servicing Facility



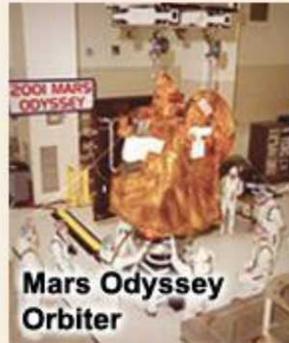
Orbiter Mate-Ops



LEM Servicing



**Space Station
Element Processing**



**Mars Odyssey
Orbiter**



LEM Integration



Orbiter Processing

Shops & Labs

- [Launch Equipment Test Facility](#)
- [Standards and Calibrations Lab](#)
- [Chemical Analysis and Sampling Laboratory \(KSC\)](#)
- [Metrology Lab](#)
- [NDE Lab](#)

Contacts

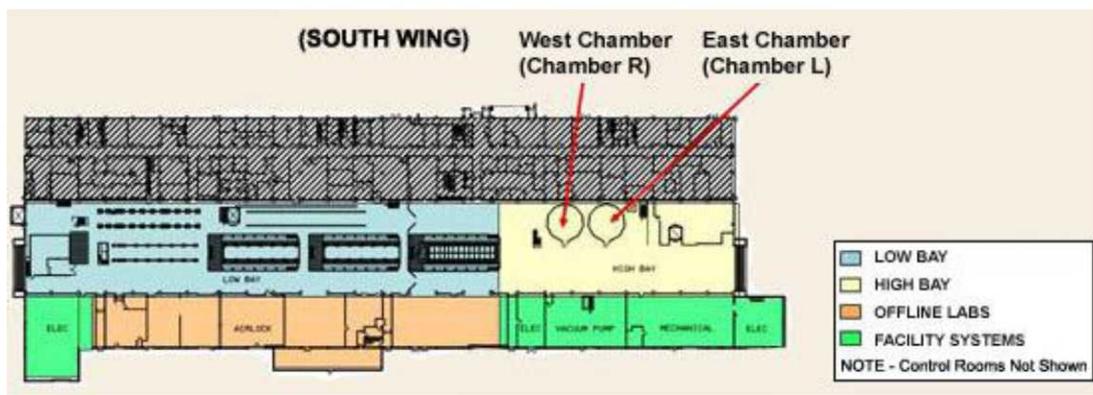
[Shaun Green](#), 321-861-4244

[George Veaudry](#), 321-867-6106

KSC Technical Capabilities

O&C Altitude Chambers

The altitude chambers in the Operations and Checkout (O&C) building were originally built in 1966 to support Apollo Lunar Excursion Module and Command Service Module operations. The chambers were man rated to an altitude of 250,000 feet. Both chambers were deactivated in 1975 at the end of the Apollo/Soyuz program, but the west chamber was refurbished in 1998 to support the test and checkout of International Space Station (ISS) pressurized elements.



Facility Capabilities



The chambers were built with a one-inch thick stainless steel exterior skin. It has characteristics that include:

- Interior dimensions of 33' diameter, 50' height
- A volume of approximately 48,000 cubic feet
- Chamber lids contain an integral groove for seals
- Contains a personnel access door located at the highbay floor level
- Max test element is 27.5 tons
- Can test an element that has a max height of 37.5 feet due to the physical crane hook height

- The chambers are no longer man rated

Success Stories

- Was utilized to test the LEM and CM during the Apollo program
- Was successfully utilized to perform element leak tests on multiple ISS pressurized modules

Contacts

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KSC Technical Capabilities

Standards & Calibration Lab

The Standards and Calibration Laboratory provides metrology services to NASA / KSC and contractor organizations. The Reference Standards Laboratory maintains the most accurate measurement standards within NASA and provides traceability to the National Institute of Standards and Technology (NIST) as required to ensure consistency. The Reference Standards Laboratory also pivots various NASA measurement assurance programs (MAPs), sharing traceability among Centers and thereby reducing costs. The Calibration laboratory calibrates and repairs a wide variety of measuring and test instrumentation. Laboratory personnel are highly skilled measurement scientists and calibration technicians with in-depth knowledge of how measuring devices work, what error sources affect them, and how to ensure accurate measurements.

Location

Central Instrumentation Facility (M6-342)

Laboratory Services

- Calibration of reference and working standards
- Metrology engineering services
- Calibration and repair of measuring and test equipment
- Precision cleaning and O2 certification of pressure and flow gauges
- Development, operation and maintenance of Metrology Information System and automated calibration processes
- In-place calibration of immovable equipment and systems
- Identification and validation of offsite calibration service providers
- Support of traceability for all seven fundamental SI units

Contacts

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KSC Technical Capabilities

Chemical Analysis & Sampling Lab

The Chemical Analysis and Sampling Lab, also known as the Wiltech Chemical Analysis Lab, provides sampling and analytical support for NASA and NASA subcontractors at the Kennedy Space Center and USAF and USAF subcontractors at the Cape Canaveral Air Force Station. A variety of sample matrices, including high pressure gases, hypergolic fuels and oxidizer, cryogenics, assorted fluids, and environmental samples are collected and analyzed to various NASA and military procurement and usage specifications and EPA requirements. Housed in a state-of-the-art facility at Bldg K6-1696, the Laboratory occupies approximately 30,000 sq. ft. comprised of several separate analytical areas including Gas, Gas Chromatography/Mass



Spectrometry, Metals, Fuel, Oxidizer, NVR, Particulate and Wet Laboratories.

Currently running experiments to study motion sickness using an off-vertical axis rotating chair and planning experiments to test a countermeasure to heat stress.

A wide range of services are performed through the Toxic Vapor Detection Laboratory involving instrument calibrations and repairs, and Material Compatibility and Permeation testing. The capabilities for in place/onsite analysis of certain gases and fluids and mercury spill support are also maintained. Laboratory personnel are highly skilled Chemists and Analysts with AA, AS, BA, BS, MS, and Ph.D. degrees. The Laboratory is ISO 9001/2000, ISO 14001, AS 9100, and NADCAP certified. In addition, the Laboratory maintains State of Florida Department of Health/NELAC certification for sampling and analysis of environmental samples for EPA requirements and hazardous waste determinations.

Laboratory Services

- Sampling and Analysis



- High pressure gases & residual gas analyses
- Hypergolic fuels and oxidizer
- Cryogenic substances
- Commodity fluids
- Environmental media
- Hazardous waste analyses
- TVD calibration and maintenance

- NVR and particulate determinations
- Material compatibility/permeation studies
- Onsite sampling/analytical support
- Mercury spill support



- Related Consultant Expertise Available
 - Analytical Procedure/Methodology Development
 - TVD Acceptance and Calibration Protocols

Laboratory Assets & Specialized Equipment

- Gas Chromatograph/Mass Spectrometers
- Gas Chromatographs with ECD/FID/TCD/NPD
- Inductively Coupled Argon Plasma Spectrophotometers
- FTIR Spectrophotometers
- UV/VIS Spectrophotometers



- Residual Gas Analyzer/Mass Spectrometer
- Ion Chromatography
- Mercury Analyzer
- Total Hydrocarbon Compound Analyzer
- Total Organic Carbon Analyzers
- Moisture Analyzers, Gas and Karl Fischer
- Stereo Microscopes
- CO2 Analyzer
- Tensiometers
- Dissolved Oxygen Meters
- Oil & Grease Extraction/Analysis
- TVD Calibration Gas Generation System
- Distillation Apparatus



- Electrical Conductivity Meter
- Flashpoint Instruments
- Wet Laboratory Capabilities
- Chromatographic Data Acquisition System
- Laboratory Information Management System
- Sampling equipment – various media

Success Stories

- Provided analytical support to the Columbia Accident Investigation Board
- Developed and implemented new analytical procedures/methodologies for Vetrel and HFE in support of Wiltech Component Refurbishment transition away from Freon based precision component cleaning
- Developed and established a Fuel Dosimeter Badging Program in conjunction with the Naval Research Laboratory
- Performed testing of new prototype TVDs for the HVDS 2000 Project
- Developed analytical procedures for H₂O₂ in support of the X-37 Project
- Developed analytical procedures for gaseous impurities in NH₃ in support of the International Space Station



- Provided analytical support for the Crawler Refurbishment Project
- Provided analytical support for the study of methods of detection of possible fuel leaks in Orbiter fuel lines
- Provided analytical support in the post Columbia study of Orbiter water system lines (NVR) evaluation
- Performed permeation testing for candidate SCAPE suit materials
- Developed calibration and acceptance procedures/protocol for new TVDs
- Performed qualification testing of new candidates for replacement gross point leak detectors to be installed at Pads 39A & B

Contacts

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KSC Technical Capabilities

Metrology Lab



The Metrology Laboratory provides rapid metrological analyses for critical measurement issues encountered with flight hardware and ground support equipment (GSE) and in support of failure analyses performed by other NASA/KSC laboratories.

In-house metrology allows independent verification of quality, alignment, fit, and finish of critical flight hardware and GSE upon their arrival at KSC, as well as dimensional analyses of anomalies (e.g., scratches on sealing surfaces, leaks, high running torques, and mechanical malfunctions) encountered during flight hardware processing.

Facility Capabilities

Laboratory Services:

- Precision measurement and dimensional analysis
- Alignment and threaded-fastener gauging
- Mold impressions of scratches, cracks, and defects
- Contractual and specification compliance measurements

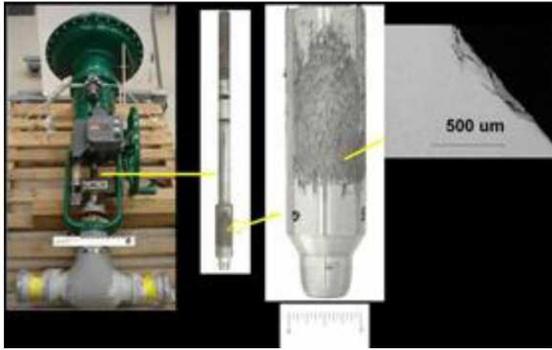
Laboratory Assets & Specialized Equipment:

- Johnson Threadview Inspection System
- Brown and Sharpe Image (computer controlled) Coordinate Measuring Machine (CMM)
- Romer Infinite Portable CMM
- Micro-Vu Optical CMM
- Mahr Surface Contour System
- Pratt and Whitney Super Micrometer
- Variety of hand tools (micrometers, calipers, height gages)
- 6' x 8' Tru-Stone granite table

Success Stories

Analysis was done to determine the cause of failure of a GN2 valve.

Failure analysis of mechanical components



- Valves
- Regulators
- Motors
- Shafts
- Bearings
- Fasteners
- Pumps

Failure analysis of mechanical systems:

- MLP fire suppression
- Torque wrench failures
- SSPF ammonia distribution
- Divator regulators
- Crane brake actuator
- Pad LOX distribution
- LC39 GN2 distribution
- Hypergolic storage

Contacts

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KSC Technical Capabilities

1.2 Payload Processing

Processing of payloads of nearly all sizes and types



Capabilities / Services

- Integration and testing / verification to provide high fidelity emulation of data, commodity and physical interfaces
- Provide pre-launch and post-landing portable power and controlled environments to sustain critical science cargo
- Provide contamination control services for highly sensitive payloads (optics)
- Capability of processing all types of ISS Orbital Replacement Units (ORU) such as gyroscopes & solar panels
- Fully assemble, integrate, test, and verify compatibility of experiments/racks

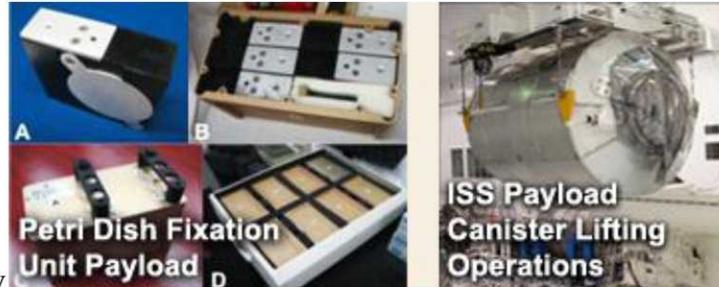
Accomplishments

- Successful launch and operation of payload and stowage items for the Shuttle and ISS Programs (132 payload installations, [31 of which were ISS](#))
- Provided payload integration including Kepler, Lunar Reconnaissance Orbiter, Solar Dynamics Observatory, and others

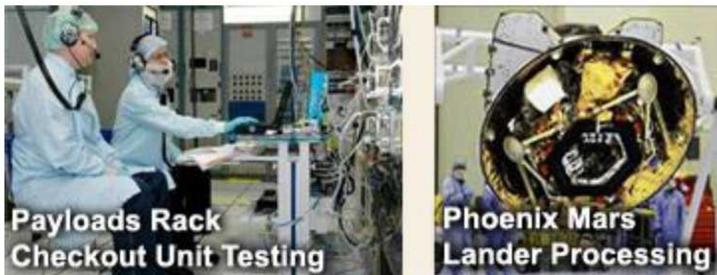
- Handling, servicing, and integration of 9 NASA science missions, including the Hubble, onto expendable launch vehicles since 2001

Equipment / Facilities

Facilities



- Orbiter Processing Facility
- Space Station Processing Facility
- Operations & Checkout Building
 - [Altitude chambers](#)
- Vehicle Assembly Building
- Launch Complex 39 and CCAFS Launch Complex
- Multi-Payload Processing Facility
- Payload Hazardous Servicing Facility
- Rotation, Processing, and Surge Facility
- Canister Rotation Facility



Equipment

- Payload carriers and strongback
- Payloads canister
- [Payload Rack and Checkout Unit](#)
- Remote Acquisition and Command Unit (RACU)
- [ISS Flight Emulator](#)

Shops & Labs

- [Launch Equipment Test Facility](#)
- [Standards and Calibrations Lab](#)
- [NDE Lab](#)
- [Metrology Lab](#)

Contacts

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KSC Technical Capabilities

Payload Rack Checkout Unit



The Payload Rack Checkout Unit (PRCU) is utilized to test payload experiment interfaces to the International Space Station. In this capacity the PRCU serves as a high fidelity emulator of on-orbit ISS interfaces and allows experiment developers to ensure that their payload will interact properly once connected on-orbit.

The KSC PRCU provides support to payload developers wanting to perform offline activities such as post-delivery checkout or periodic maintenance. In some instances the PRCU is utilized to perform online testing of an experiment to buy off final requirements prior to the payload being flown to ISS.

Facility Capabilities

Electrical Power Subsystem (EPS)

- 120 VDC Programmable Electrical Power Supply Emulator (PEPSE)
 - Local and remote control
 - Output Current (up to 120A), Output Voltage (up to 210 VDC), Slew Rate, Current Limit settings/ measurements
 - Emulates U.S. Lab Remote Power Control Modules (RPCMs) with adjustable Current Limit Delay, Slew Rate, and Current Setting
- Impedance Analysis Assembly (IAA)
 - In-Rush Current Analysis, typically < 10us
 - Impedance Graphic Representation from 1 Hz to 1 MHz

Command & Data Handling (C&DH)

- Low Rate Data Link (LRDL), Medium Rate Data Link (MRDL), and High Rate Data Link (HRDL) emulation
- Payload Multiplexer/DeMultiplexer (PL MDM) Flight equivalent Unit (FEU)
- Portable Computer System (PCS) FEU
- Sun Workstation simulates Command and Control (C&C) MDM functions for PL MDM

- Payload Ethernet Hub Gateway (PEHG) simulations
- Command tables hand-built using PRCU tools

Fluids / Structures

- Thermal Control System (TCS)
 - Moderate Temperature Chiller
 - Low Temperature Chiller
 - Rack Flow, System Flow, Temperature, Delta Pressure measurements
- Gaseous Nitrogen
- Vacuum Exhaust & Resource
- Raised Access Floor with active fire alarms sensors, and Support Structure

Video

- Differential or Single-Ended
- Common Video Interface Unit (CVIU) for conversion of Pulse Frequency Modulation (PFM) to National Television System Committee (NTSC) video
- NTSC Video Signal Generator
- Light wave Multi-meter
- Waveform Analyzer

Success Stories

The KSC PRCU has been utilized to test a multitude of experiment racks. Some of the recent experiments that have been tested to support the STS-126 flight are:



- Microgravity Experiment Research Locker Incubator II (MERLIN)
- General Laboratory Active Cryogenic ISS Equipment (GLACIER)
- Space Dynamically Responding Ultrasonic Matrix System (SpaceDRUMS)
- Express Rack 6
- Potable Water Dispenser (PWD)
- Combustion Integrated Rack (CIR)

In addition to experiment testing the PRCU is planned to be utilized to support checkout of Orbital Replacement Units (ORUs) that will fly on the Express Logistics Carriers (ELC).

Contacts

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KSC Technical Capabilities

ISS Flight Emulator



The International Space Station flight emulator supports ground test and verification of flight avionics interfaces to ISS modules and elements at KSC. Intended to emulate power, avionics, and data interfaces with other ISS components that may already be on-orbit or not yet delivered or available to support integrated testing. The emulator is planned to be utilized to ensure that the upcoming ORION vehicle will successfully communicate with the International Space Station prior to arrival.

Facility Capabilities

The Emulator consists of program provided avionics devices (flight-like or functional equivalent units) integrated with KSC developed cables, racks, and support structures. In addition the emulator has a portable design that allows it to be located anywhere in the KSC Industrial Area. This design is highly flexible and modular allowing for a variety of test configurations based on changing requirements.

Some of the specific capabilities of the flight emulator include:

- Space Station Multiplexer-DeMultiplexer (SSMDM) functional equivalent units execute same system and application code as loaded in flight MDMs providing identical software interfaces as seen on-orbit
- Commanding and monitoring of flight hardware and FE subsystems provided by standard U.S. ISS Portable Computer System (PCS) units.
- Several MDM Application Test Environment (MATE) systems are located on the FE and are capable of executing program developed software simulations of missing or unavailable flight components or systems
- Command and control Environment Simulation (CES) available as a standard feature provides simulation of air-to-ground command and telemetry links, scripting engine for development and execution of automated test scripts, and external time source (IRIG-B).
- It does not support fluid and gas interfaces

Success Stories

The flight emulator has successfully been utilized to support:

- Numerous ISS test campaigns of varying degrees of complexity over the past five years
- MEIT II and III
- CSA Mobile Base System (MBS) testing
- Integrated truss segment Post Software Load Initialization Tests (PSLITs)
- JEM standalone and end-to-end tests
- Flight space unit test and checkout (CMG, MDM, etc.)
- Node 2 powered testing

Contacts

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KSC Technical Capabilities

1.3 Launch Vehicle Processing

Decades of experience in the handling of large launch vehicle elements



Capabilities / Services

- Expertise in [processing](#), launching, and recovery of expendable and reusable launch vehicles
- Assembly, transport, handling, and integrated testing
- Real-time anomaly resolution
- Spacecraft / launch vehicle integration
- [Commodity servicing / de-servicing](#)
- Terminal launch countdown system expertise

- Provided engineering services for all NASA expendable launch vehicle processing including integration, testing, and launch
- Delivery services to KSC via [road](#), [rail](#), [air](#), [barge](#), or [space](#)
- Ascent imagery analysis expertise

Accomplishments

- Successfully stacked / interface mating verification of 132 Space Shuttles, 1 Ares I-X, 10 Saturn I 's, 9 Saturn I-B's, and 13 Saturn V's
- Modified infrastructure / ground support equipment to support program objectives (Shuttle & [Ares I-X](#))
- Successful water recovery of 260+ Space Shuttle Solid Rocket Boosters

Equipment / Facilities

Facilities

- Orbiter Processing Facility
- Vehicle Assembly Building
- Launch Complex 39 and CCAFS Launch Complex
- Shuttle Landing Facility
- Space Shuttle Main Engine Processing Facility
- Rotation, Processing, and Surge Facility

Equipment

- Crawler transporter
- Retractable platforms
- [Launch towers](#)
- Kennedy Avionics Test Set (KATS) Laboratory

Shops & Labs

- [Launch Equipment Test Facility](#)
- [Standards and Calibrations Lab](#)
- [Chemical analysis and sampling laboratory](#) (KSC)
- [NDE Lab](#)
- [Imagery Analysis Facility](#)
- [Metrology Lab](#)



Contacts

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[George Veaudry](#), 321-867-6106

<http://kscpartnerships.ksc.nasa.gov/techCap/chemAnalysis.htm>

KSC Technical Capabilities

Chemical Analysis & Sampling Lab

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Laboratory Services

- Sampling and Analysis



- High pressure gases & residual gas analyses

- Hypergolic fuels and oxidizer
- Cryogenic substances
- Commodity fluids
- Environmental media
- Hazardous waste analyses
- TVD calibration and maintenance
- NVR and particulate determinations
- Material compatibility/permeation studies
- Onsite sampling/analytical support
- Mercury spill support



- Related Consultant Expertise Available
 - Analytical Procedure/Methodology Development
 - TVD Acceptance and Calibration Protocols

Laboratory Assets & Specialized Equipment

- Gas Chromatograph/Mass Spectrometers
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- Inductively Coupled Argon Plasma Spectrophotometers
- FTIR Spectrophotometers
- UV/VIS Spectrophotometers



- Residual Gas Analyzer/Mass Spectrometer
- Ion Chromatography
- Mercury Analyzer
- Total Hydrocarbon Compound Analyzer
- Total Organic Carbon Analyzers
- Moisture Analyzers, Gas and Karl Fischer
- Stereo Microscopes
- CO2 Analyzer
- Tensiometers
- Dissolved Oxygen Meters

- Oil & Grease Extraction/Analysis
- TVD Calibration Gas Generation System
- Distillation Apparatus



- Electrical Conductivity Meter
- Flashpoint Instruments
- Wet Laboratory Capabilities
- Chromatographic Data Acquisition System
- Laboratory Information Management System
- Sampling equipment – various media

Success Stories

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Contacts

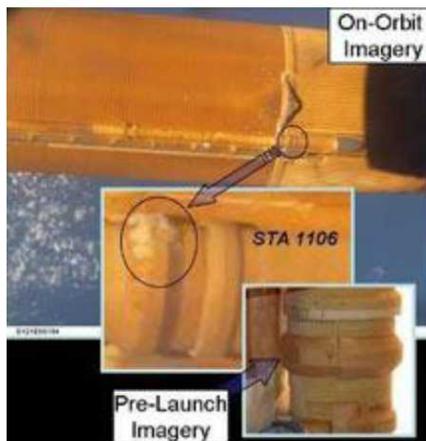
[Steve Williamson](#), 321-861-2454

[Judy Kler](#), 321-861-2456

KSC Technical Capabilities

Imagery Analysis Facility

The Imagery Analysis Facility (IAF) is a state-of-the-art imagery facility that supports various programs, primarily NASA's Space Shuttle Program, by analyzing films and digital images during launch, while on-orbit, and during landing. Imagery Analysis requests continually are received throughout missions requesting help in evaluating unexplained anomalies, "items-of-interest", or simply "one-of-a-kind" issues (i.e. first time occurrences), and to resolve safety concerns and/or potential hazardous situations.



During countdown for each Space Shuttle Mission, the IAF is fully staffed and ready to support 24/7. Within 4-5 days of launch, IAF reviews hundreds of films, videos, and digital images. Every frame of each film is viewed and all "items-of-interest" are annotated for further evaluation. Imagery is downloaded from the Space Shuttle's External Tank, Solid Rocket Boosters, and the Orbiter itself. During the mission, imagery is also downloaded from the astronauts for analysis. All landing imagery is collected, reviewed, and evaluated for any potential runway issues.



Then Imagery Analysis Facility retains "engineering copies" (film) on-site since the beginning of the Space Shuttle Program (launch of STS-1: April 1981). Each launch and landing film is scanned to provide an ultra-

high digitized copy for additional engineering evaluation. A single Space Shuttle mission contains over 16 terabytes of imagery data and requires over 60 data backup tapes to store the data for future engineering evaluation.

IAF also provides support to Constellation Program, Expendable Launch Vehicles, On-Orbit Imagery (Shuttle and Space Station), and to numerous Law Enforcement Agencies across the country. In addition to high definition imagery, IAF displays launch/landing films in the following formats; 16mm, 35mm, and 70mm. Up to three different projection systems can be used simultaneously for side-by-side comparisons.

Success Stories

During the Space Shuttle Columbia investigation and reconstruction efforts, IAF provided tremendous insight about the launch debris event which led investigators to a better understanding of the cause of the catastrophe.

For more information, please contact [Scott Lockwood](#)

KSC Technical Capabilities

1.4 Avionics Test & Checkout

Decades of experience in testing and development of avionics systems

Capabilities / Services



- Real-time field test and checkout
 - Launch vehicle, spacecraft, and payload avionics installation, processing, troubleshooting and launch
 - Flight computers, software, and data handling
 - Sensors and instrumentation
 - Flight audio and video systems
 - Guidance, navigation, and flight controls
 - Propulsion avionics
 - Flight RF and telemetry systems
- Offline laboratory test and checkout
 - Kennedy Avionics Test Set (KATS)
 - Software development utilizing a combination of flight equivalent hardware and math models
 - Troubleshooting avionics systems
 - Data bus analysis
 - Software loading of actual flight computers and display systems
 - Propulsion avionics system simulation environment

Accomplishments

- Successfully retrofitted and integrated Shuttle fleet with upgraded avionics systems; display systems, flight computers, and advanced health management systems
- Assembled, processed, and launched flight control system and developmental instrumentation on flight test vehicle, Ares I-X
- Integrated Space Shuttle heritage avionics flight hardware with Atlas V derived avionics flight hardware onto Ares I-X

Equipment / Facilities



Facilities

- Space Shuttle Main Engine Processing Facility
- Space Station Processing Facility
- Vehicle Assembly Building
- Launch Complex 39 and CCAFS Launch Complex
- Ground Software Production Facility

Shops & Labs

- Kennedy Avionics Test Set

Contacts

[Arnold Postell](#), 321-861-3771

[George Veaudry](#), 321-867-6106

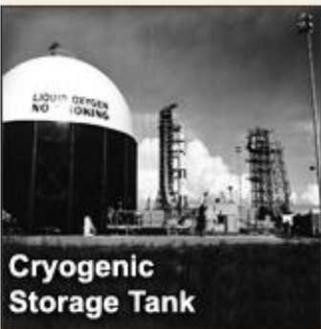
<http://kscpartnerships.ksc.nasa.gov/techCap/commodity.htm>

KSC Technical Capabilities

1.5 Commodity, Handling, and Servicing

Hazardous and non-hazardous flight hardware servicing expertise

Capabilities / Services



- Storage, handling, and servicing / de-servicing expertise
 - Hypergolic, cryogenic, potable water, Freon, ammonia, specialty coolants, helium, nitrogen, and hydraulic fluid
 - Propellant conditioning services
 - Composite Overwrapped Pressure Vessel (COPV) and pneumatic system servicing expertise
- On-site commodity sampling lab for particulate (less than 5 microns) and purity
- [Material compatibility](#) testing for several fluids including hypergolics and cryogenics
- Advanced leak detection capabilities
- Expertise in software development
- [Personal protective equipment development](#)

Accomplishments

- Safely loaded more than 390,000 gallons of hypergolic propellants onto the Space Shuttle
- [Serviced hypergols](#) onto 9 NASA science mission spacecraft
- Over 235 Space Shuttle cryogenic servicing and 90+ successful cryogenic deservicing operations
- Active lessons learned program incorporated to increase operational safety and reduce timelines
 - Space Shuttle high pressure gas pad clear operations timeline reduced by approximately 52% over 11 flights through process improvement
 - Decreased Space Shuttle hypergolic propellant loading pad clear operations from days in length to about 36 hours per load through software automation and parallel operations
- Safely loaded ammonia onto 100+ Space Shuttles, 7 ISS truss elements, and 5 ammonia tank assemblies

Equipment / Facilities

Facilities

- Orbiter Processing Facility
- Hypergolic Maintenance Facility
- Space Station Processing Facility (non-hazardous)
- Operations & Checkout Facility (non-hazardous)
- Launch Complex 39
- Multi-Payload Processing Facility
- Space Shuttle Main Engine Processing Facility
- Rotation, Processing, and Surge Facility

Shops & Labs

- [Chemical analysis and sampling laboratory](#) (KSC)
- Chemical sampling lab (CCAFS)
- [Launch Equipment Test Facility](#)
- [Standards and Calibrations Lab](#)
- [NDE Lab](#)
- [Cryogenic Test Lab](#)



- [Metrology Lab](#)

Contacts

[Henry Bursian](#), 321-867-3870

[George Veaudry](#), 321-867-6106

KSC Technical Capabilities

Cryogenics Test Laboratory

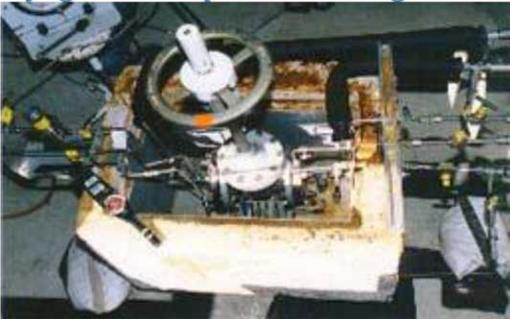
The Cryogenics Test Laboratory focuses on research and development in areas such as thermal insulation systems, cryogenic components test and evaluation, low-temperature applications, and propellant servicing systems. The objectives of this laboratory are to develop materials, produce new technology, and promote engineering for energy-efficient storage, transfer, and use of cryogenics and cryogenic propellants on Earth and in space.

Thermal Insulation Systems

A cornerstone of the Cryogenics Test Lab is the thermal insulation systems area that includes a family of research test cryostats. The Cryogenics Test Lab specializes in the development of high efficiency insulation systems to meet the unique requirements of space applications. This research is centered around the development of new insulation systems that reduce the life cycle costs of cryogenic storage systems. A full range of insulation testing apparatus is available for the development and characterization of new insulation systems.

New high-efficiency insulation systems were developed for a wide range of technology needs, including both flight hardware and ground system aerospace applications. Numerous patents and New Technology Reports have resulted from this research.

Cryogenic component testing and evaluation



The Cryogenic Test Lab is well suited to perform specialized development and testing of cryogenic components for both space and ground based applications.

The Cryogenics Test Lab staff has extensive knowledge in the area of material compatibility, sealing technologies, manufacturability and leak detection.

The Cryogenics Test Lab is capable of testing the entire spectrum of performance and environmental conditions for cryogenic services.

Success Stories

A 320-pound power drive unit (PDU) failed during a routine test on STS-101. The Cryogenics Test Lab devised a method that allowed the component to be replaced on the Shuttle in a vertical position.



By wrapping liquid nitrogen cooled tubing around the outside of the titanium lines, hydraulic fluid was frozen and maintained the “frozen plugs” throughout the 30-hour PDU change-out process.

The Solid Rocket Motor Transporter steering cylinder had failed. The Cryogenics Test Lab devised a method that allowed the cylinder to be replaced without damaging the heat-sensitive seals and interference fit pins. By cryogenically cooling the pins, they shrunk in diameter enough to be installed without any damage to the cylinder.

The Cryo Test Lab led the certification integrity testing of the redesigned external connector for STS-122 and STS-123. The Lab also supported the on-pad Space Shuttle tanking test which allowed the failure within the ECO sensor circuit to be identified. Without the testing in the Cryo Test Lab the Electrical Engineers would have had much more difficulty interpreting the Time Domain Reflectometry signals. Finally, the Cryo Test Lab supported the ECO Sensor Long Term Resolution Team by design and support solutions to test root cause scenarios.

Facility Capabilities

- Thermal insulation systems research and development
- Cryogenic component testing and evaluation
- Low-temperature applications
- Propellant servicing systems planning and integration
- Cryogenic system and instrumentation prototype construction testing
- Research of new composite insulation materials
- Development of high-performance insulation systems
- Thermal performance testing under actual-use cryogenic-vacuum conditions
- Mechanical and sealing technology design expertise
- Operational use experience
- Performance testing capabilities for valves, pumps, and sensors
- Aerospace and industry low-temperature applications
- Energy applications for power transmission
- Medical and biology applications
- Integration of cryocoolers and refrigeration systems

- Energy-efficient propellant storage and transfer system design
- Zero-boil-off technology
- Autonomous control
- Hydrogen economy applications
- Liquid nitrogen supply systems for flow testing and laboratory operations
- Specialized cryostats for insulation material testing
- High-vacuum pumping and instrumentation equipment
- Field-testing capability of insulated piping systems
- High-volume gaseous-nitrogen flow testing
- Helium leak testing
- Adaptable data acquisition and instrumentation capabilities
- Fully equipped general-use laboratory and high-bay work space
- Class 100 clean-room

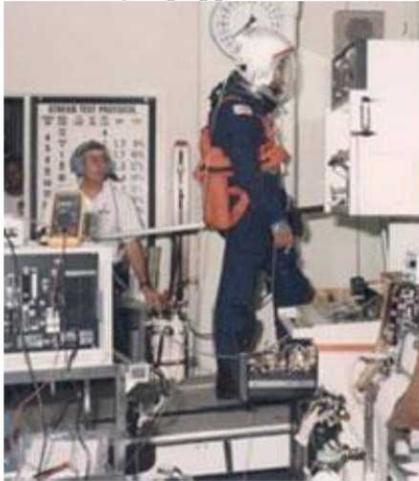
Contact

[James Fesmire](#), 321-867-7557

KSC Technical Capabilities

BioMedical Laboratory

The BioMedical Lab is fully equipped to conduct lab experiments and field testing on a wide variety of



manned systems. Capabilities include, but are not limited to, testing of advanced forms of personal protective equipment, biomedical signal acquisition and analysis, and physiological and metabolic tests and analyses. Also design, test and fabricate the systems and equipment related to these capabilities. Specialties include the manufacture, maintenance, and testing of cryogenic breathing systems and whole-body protective suits which are unique to this laboratory. Also develop and conduct various physiological protocols. Currently running experiments to study motion sickness using an off-vertical axis rotating chair and planning experiments to test a countermeasure to heat stress.

Engineering and technical support for space operations: Engineering and technical support is provided to customers in the design, fabrication, test and operation of emergency medical equipment. This support includes emergency radio frequency (RF) communications and triage site electronic data exchange systems to support astronaut rescue at both KSC and transatlantic landing sites. Platforms include NASA and Department of Defense helicopters, ambulances, and M-113 armored, personnel carriers. Pre- and post-flight support of medically related detailed supplementary objectives for flight crew is also provided.

Laboratory Services

- Design, fabrication, and testing of personal protective equipment and breathing apparatus prototypes
- Design and fabrication of emergency medical equipment and communications devices
- Design and implementation of physiological protocols for human testing, both lab based and remotely (i.e. in the field) with portable instrumentation
- Physiological and metabolic data acquisition, monitoring and analysis
- Lab VIEW development system with data acquisition capabilities
- IOtech data acquisition
- MA TLAB mathematical analysis software with signal processing toolkit
- Dataq based data acquisition and data analysis



- WinCPRS based data analysis of cardiovascular and respiratory data
- Tool design & fabrication
- Vector Works drafting and drawing toll software

Laboratory Assets and Specialized Equipment

- Quick Circuit 7000 Computer Numeric Control (CNC) Mill
- Quinton Stress Test Monitor/Controller/treadmill
- Konigsberg Telemetry System
- Supercritical Air cryogenic loading system
- Biosystem Posicheck 3 SCBA Test System
- Rosemont NGA 2000 Gas Analyzer
- Nonnocap Respiratory Gas Analyzer
- Ultrasound Doppler measurements of blood flow velocities
- Finometer, Portapres and ECG for real-time measurements of blood pressure and heart rate
- COSMED portable gas analyzer
- Off-vertical axis rotating chair for human motion sickness studies
- Bruel and Kjaer PULSE head and torso stimulator for advanced acoustics testing

Success Stories

One of the Biomedical Labs developed technologies is the ResQPOD. ResQPOD is a non-invasive medical device that improves cardiac output and blood flow to the brain compared to conventional resuscitation techniques. At NASA, it is used to help astronauts reacquaint with the feeling of gravity by quickly and effectively increasing the circulation of blood flow to the brain. Emergency medical services, hospitals and the



U.S. military also use ResQPOD.

The lab successfully designs, tests, and evaluates unique forms of Life Support equipment and systems (whole body suits and breathing apparatus) to protect against rocket propellants and other KSC hazards.

Capability POC

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Phone: 321-861-3687

Email: [Don Doerr](mailto:Don.Doerr)

<http://kscpartnerships.ksc.nasa.gov/techCap/weather.htm>

KSC Technical Capabilities

1.6 Weather Technology and Radar Debris Diagnostics

Minimize adverse weather effects on operations and monitor in-flight assets / debris

Capabilities / Services



KSC Wind Profiler



LDAR Sensor



C-Band Radar Station



**Doppler Radar
Wind Profiler**



**Pad 39B Lightning
Towers & Area 1-Y**

Weather

- Development of weather constraints for ground process and launch operations
 - Provide weather consulting for engineering analysis and design
- Design and execution of weather research programs
 - Transition from the research environment to operations
- Provision of day-of-launch wind profiler data to reduce ascent risk to all vehicles at KSC/CCAFS
- Instrumented lightning protection systems on LC-39A and LC-39B

Radar

- Real-time launch tracking of vehicle radar signature, staging dynamics, debris events, and plume signature
 - Radar data to identify release site, reconstruct trajectory, dimensions (less than 0.5 in²), and material composition of liberated debris
 - Relative in-flight motion, bending, and flexure detection within the vehicle stack (includes wings, tail, and engines)

Accomplishments

Weather

- Award-winning [Applied Meteorology Unit](#) developed or transitioned numerous weather technologies
- Transitioned 50 MHz Doppler radar wind profiler to operations, significantly reducing risk of a wind-induced anomalies
- Developed Lightning Detection and Ranging (LDAR) system
- Implemented two phase lightning policy in mid-1990's saving KSC in excess of \$1M annually in lost down time, other agencies adopted policy
- Upgraded lightning launch commit criteria to increase launch availability and improve safety

Radar

- Detected and tracked astronaut tool bag lost during STS-126 EVA
- Successful ARES I-X relative in-flight motion detection of 0.2 to 0.4 inches

Equipment / Facilities

NASA Weather Systems

- [50 MHz Doppler Radar Wind Profiler](#) (DRWP)
- [Applied Meteorology Unit](#)
- Weather Data Archive
- Wind, temperature, and humidity measurements on three lightning protection towers at LC-39B
- Portable hail detection and sizing equipment (10 to 20+ mm)

NASA Debris/Diagnostic Radar Systems

- High resolution C-Band wide-band, coherent radar
- Two X-Band Weibel Doppler radars (portable) – offshore & down range operations
 - Advanced software tools for ascent or orbital object analysis

Contacts

Weather

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Radar

[John Creech](#), 321-867-4395

[George Veaudry](#), 321-867-6106

KSC Technical Capabilities

Applied Meteorology Unit

The Applied Meteorology Unit (AMU) develops, evaluates, tailors, and transitions technology to improve weather support to spaceport and range operations. It is operated under a joint NASA – Air Force – National Weather Service Memorandum of Understanding. Relevant technologies include meteorological instrumentation; atmospheric data analysis; weather forecasting algorithms and indices; and numerical weather prediction, data assimilation, and modeling. The AMU personnel encompass a broad range of expertise, including computational fluid dynamics, computer programming, data analysis and statistics, instrumentation, and weather support to spaceport and range operations. AMU uses the [50 MHz Doppler Radar Wind Profiler](#), lightning detection systems, weather towers, weather radars, 915 MHz Doppler wind profilers, weather balloons, satellite observations and other sources of weather data to perform its development, evaluation, tailoring and transition functions.

Location



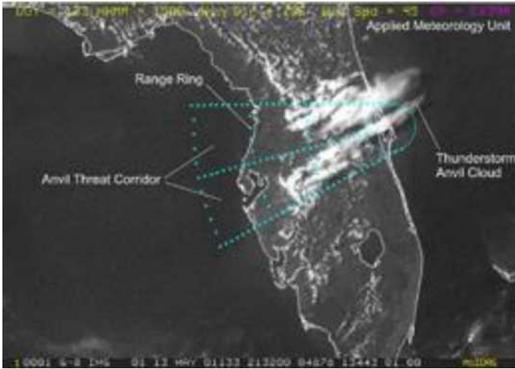
Morrell Operations Center (MOC) Bldg. (81900)

Facility Capabilities

- Anvil Forecast Tool
- Numerical Weather Prediction
- Sensor Evaluation
- Severe Weather Event
- Shuttle Optical Imaging - Statistical model of cloud field

Success Stories

Developed and installed a method to determine the threat of violating the thunderstorm anvil rule in the lightning launch commit criteria that govern all vehicles launched from the Eastern Range.



Developed an automated objective algorithm for identifying sea breeze fronts in gridded numerical weather forecasts and observed data. Previous automated processes were unreliable, necessitating a labor-intensive, subjective, manual review before the data could be used.

Developed an automated method to use the sea breeze identification algorithm to evaluate the performance of the numerical forecasts against the actual observations. Classical point-verification statistics cannot capture phenomenological success or failure in a high-resolution model prediction. The new method accounts for timing and location displacements that cripple the classical methods.

Contacts

[Dr. Frank Merceret](#), 321-867-0818

KSC Technical Capabilities

The 50 MHz Doppler Radar Wind Profiler

The 50 MHz Doppler Radar Wind Profiler (DRWP) is a part of the [Applied Meteorology Unit](#). It was installed in the late 1980's, provides upper air wind profiles from 2-18 km every 5 minutes at a vertical sampling



interval of 150m.

It detects differences between the actual upper level winds and those measured by balloons. Significant spatial and temporal wind differences can be caused by upper winds which blow a balloon far from the vehicle flight path and the balloon's rise time which requires an hour to reach the altitude of maximum vehicle dynamic loading. Accuracy equals that of the best available high-accuracy wind-finding balloons. The instrument consists of a 50 MHz pulsed Doppler radar transceiver, associated control and data processing computers and a 15,000 square meter coaxial-colinear phased array antenna. The NASA-developed wind-finding software includes the best automated quality control algorithm for wind profilers currently available. Additional day of launch manual quality control is provided by the Range Technical Services Contractor.

Success Stories

On 10 April 2003, the Atlas-Centaur 205 launch attempt was scrubbed based on DRWP winds. The latest pre-launch balloon measurements indicated that it was safe to launch but the profiler revealed large wind changes had occurred near the launch site within half an hour before the scheduled launch time. The mission launched successfully the following day. Later analysis using balloon data from after the scheduled launch time showed that if the DRWP data had not been used to call a halt to the countdown, AC-205 would have launched into wind conditions that would have caused loss of the mission.

In March 2001 Atlas Centaur 157 delayed launching based on DRWP wind profiles which showed large wind changes had taken place over the launch site since the last available balloon data. The window was long enough that new steering commands could be uploaded to the vehicle within the launch window and the launch took place successfully. If the DRWP data had not been available, AC-157 would have launched into unacceptable wind conditions.

Contacts

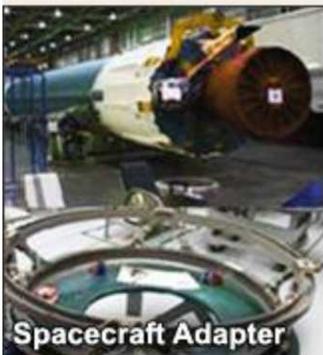
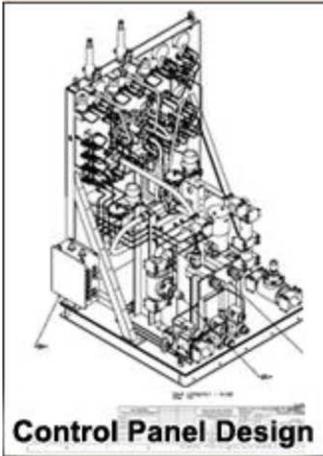
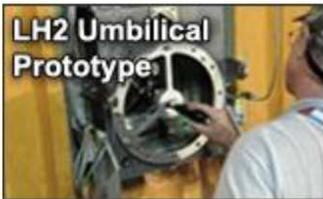
[John Madura](#), 321-867-0818

KSC Technical Capabilities

2.0 Design & Analysis Solutions

Expertise in design (ground systems and flight interfaces) for full life cycle from concepts, prototypes, modeling & simulations, design specifications and drawings, fabrication through acceptance and sustaining.

Mechanical, electrical, fluids, avionics, and command & control; including time-zero umbilical system development and launch induced environments.



2.1 Prototype Design and Fabrication

- Multi-discipline services for design, analysis, fabrication and testing of prototypes (such as system components, test articles, test support equipment). Includes quick turnaround troubleshooting and design for manufacturability. ([read more](#))

2.2 Design of Ground Systems and Flight Interfaces

- Multi-discipline Design services for full life cycle - from concepts, trade studies, design specifications and drawings, and analysis. Includes procedures and support through acceptance testing, component qualification, and verification. ([read more](#))

2.3 Sustaining Engineering of Ground and Flight Systems

- Multi-discipline Engineering services for post initial system development, used to modify the form, fit or function of existing ground and flight systems for upgrades, obsolesce, anomaly resolution, and re-certifications. ([read more](#))

2.4 Umbilical System Development

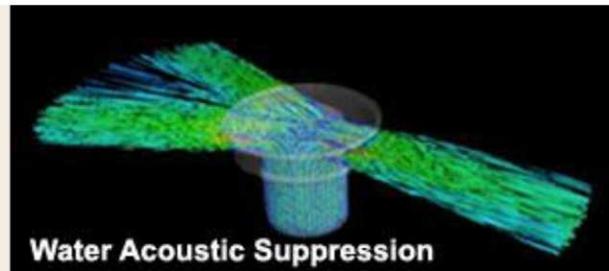
- Design services for umbilicals (including Time –Zero, flight and ground side) and associated retract systems (automated & technician assisted mate designs). ([read more](#))

2.5 Launch Induced Environments - Design / Analysis

- Analytical modeling services for the prediction of the Launch Induced Environments, and design of GSE to accommodate the results - for over/under pressures, acoustics, vibration, thermal, & corrosion effects. ([read more](#))

2.6 Flight Vehicle Design Certification

- Independent analysis and certification by KSC engineering services including commercial launches. ([read more](#))



<http://kscpartnerships.ksc.nasa.gov/techCap/prototype.htm>

KSC Technical Capabilities

2.1 Prototype Design and Fabrication

Quick turnaround & troubleshooting tools and test equipment



Capabilities / Services

- Design, fabrication and testing of prototypes, test articles and test support equipment
- Real-time prototypes to facilitate rapid solutions to complex problems
- Consulting for “Design for Manufacturability”
- Research test article and test fixture design and fabrication support

Accomplishments

- Design and manufacturing of specialized tooling, flight hardware and support equipment components for resolution of launch constraints
 - X-33, ISS, Shuttle, and ELV
- Constellation design and manufacture support for prototype hardware, e.g. Orion Crew Module to White Room Interface and Aft Bay Simulator
- Design and fabrication of GSE and flight hardware of Ares I-X, e.g. Stack 5 Lifting Fixture, numerous sensor brackets
- 1/7 scale Delta IV launch duct for validating over / under-pressure modeling
- Taurus II –fairing air flow mockup / test

Equipment / Facilities

Shops & Labs

- Prototype Lab
- Machine Shop
- Weld Shop
- Pneumatics Shop
- Cable Fabrication

Contacts

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<http://kscpartnerships.ksc.nasa.gov/techCap/interfaces.htm>

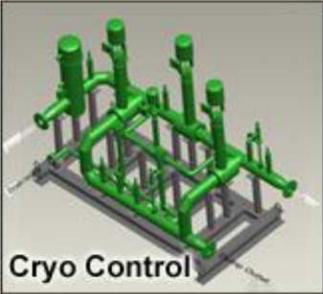
KSC Technical Capabilities

2.2 Design of Ground Systems and Flight Interfaces

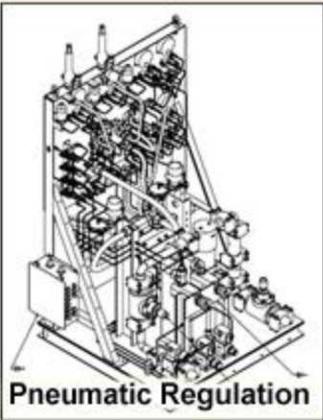
Multi-discipline life cycle design engineering at KSC for 50 years



Control Console



Cryo Control



Pneumatic Regulation



Umbilical Arms



**Process Flow
Modeling &
Simulation**



Continuous Risk Mgmt

Capabilities / Services

- Mechanical: Launch accessories / umbilicals, handling and access
- Fluids & Propulsion: hypergol, cryogenic, hydraulic, high pressure pneumatic, environmental control and life support air systems
- Avionics
- Electrical (including Electromagnetic)
- Materials Science (materials & processing)
- Information Technology (IT)
- Ground command and control systems
- Fracture mechanics
- Systems engineering
- Pyrotechnics

Accomplishments

- Design development of facilities / GSE for:
 - Apollo, Space Station, Shuttle, Constellation, and Commercial Processing
 - Examples include X-33 T-0 umbilicals, supercritical GHe systems, Launch Structures, command / control, etc. for a 0.9999 availability
- Active Committee members: ASTM, ASME, NACE, AIAA, SAE, IEEE, & NFPA
- PhD level support in all major disciplines
- Several \$B in ground system development for Shuttle, ISS and CxP

Tools / Codes

- Library and Tech Data Systems
- CAD systems
 - Pro E
 - Microstation
 - AutoCAD
- Analysis
 - Sinda-Fluint
 - NASTRAN / ANSYS
 - Pipepak
 - NASGRO
- Industry Code Knowledge (typical)
 - ASTM / ASME codes
 - AISC codes
 - NFPA / NEC / UL / IEEE
 - DOT
- AFSPCMAN (45thSW & VAFB) AFSPCMAN (45thSW & VAFB)

Contacts

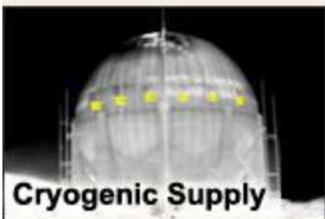
[Hector Delgado](#), 321-867-9295

[George Veaudry](#), 321-867-6106

KSC Technical Capabilities

2.3 Sustaining Engineering of Ground and Flight Systems

Sustaining engineering at KSC for 50 years



Capabilities / Services

- Mechanical: Launch accessories / umbilicals, handling and access
- Fluids Systems Engineering: hypergol, cryogenic, hydraulic, pneumatic, environmental air systems
- Avionics
- Electrical
- Materials Science
- Information Technology (IT)
- Ground Command and Control Systems
- Pressure Vessel / System Re-Certification
- Mishap Investigation
- Test and Measurement Services

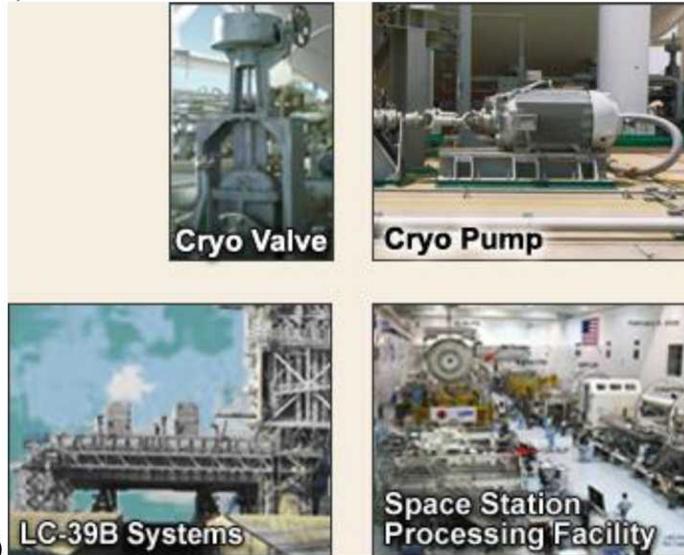
Accomplishments

- Launch availability / reliability record of 98.4% for Facility Systems and GSE induced scrub anomalies including Command / Control and Software
- Reduced annual maintenance costs

Equipment / Facilities

Sustaining Engineering of Launch Complex and Payload processing Facilities / GSE:

- Launch Complex 39 A and B
- Vertical Assembly Building (VAB)



- Orbiter Processing Facility (OPF)
- Space Station Processing Facility (SSPF)
- Operations & Checkout Facility (O&C)
- Multi-Payload Processing Facility (MPPF)
- Payload Hazardous Servicing Facility (PHSF)
- Hypergol Maintenance Facility (HMF)
- Launch Equipment Test Facility (LETF)
- Firing Rooms (Launch Control Center)

Contacts

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[George Veaudry](#), 321-867-6106

KSC Technical Capabilities

2.4 Umbilical System Development

Umbilical design is a core capability for KSC

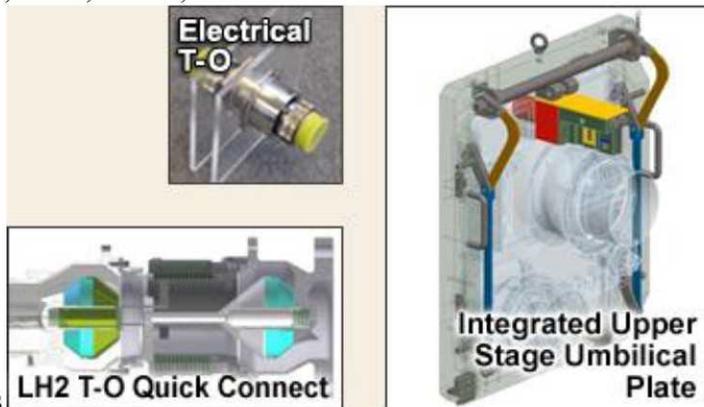


Capabilities / Services

- Integrated design of both ground and flight side components at KSC
- Automated & technician assisted umbilical mating
- Experience with active retractable and passive rise-off styles
- Ultra-reliable mechanical, electrical or fluid / pneumatic Time Zero (T-0) disconnect

Accomplishments

- Umbilical designs and testing for Shuttle, X-33, Ares I, and Commercial



- Delta IV ECS, Atlas V autocouplers

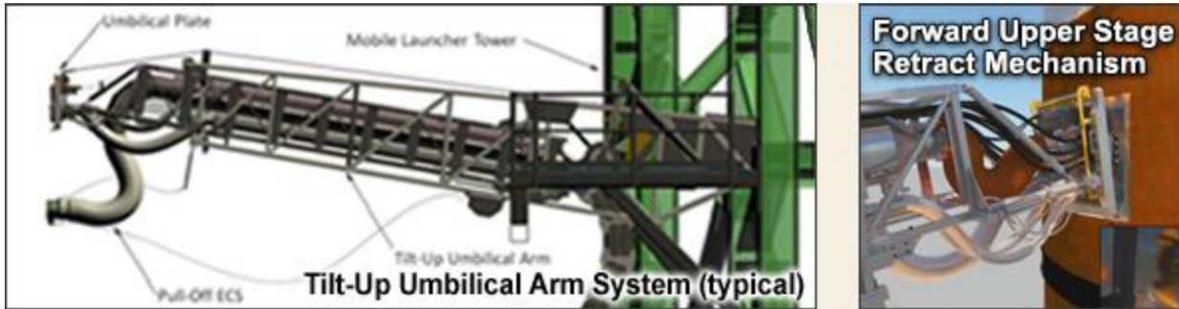
Equipment / Facilities

- Launch Equipment Test Facility
- Machine Shops / Prototype Shops

Contacts

[Joseph Porta](#), 321-867-3748

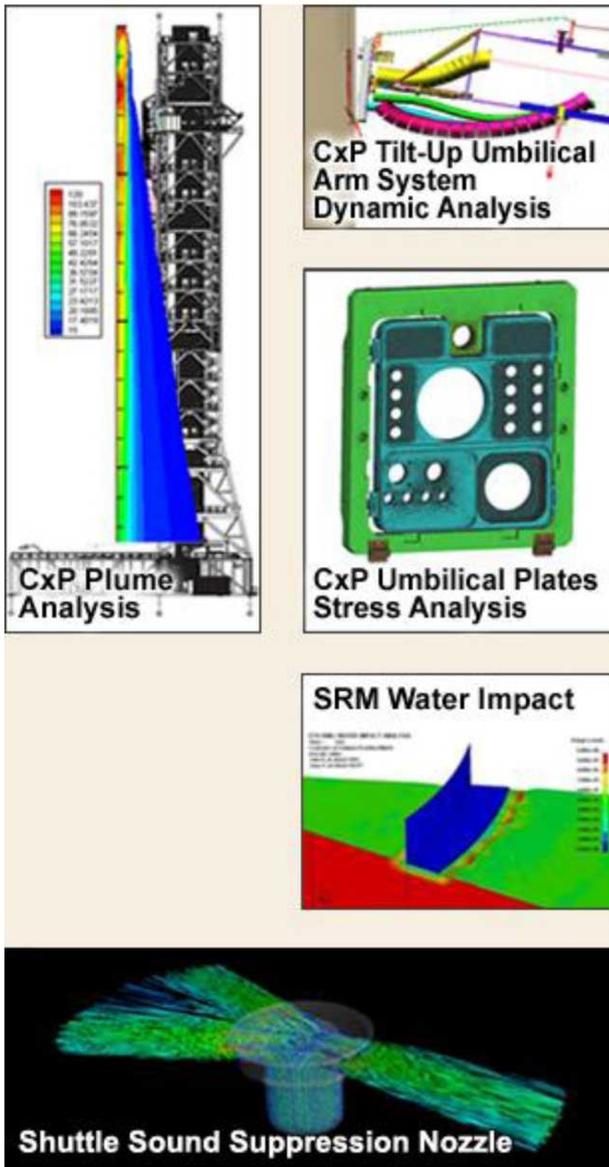
[George Veaudry](#), 321-867-6106



KSC Technical Capabilities

2.5 Launch Induced Environments - Design / Analysis

Launch environment analysis is a core capability for KSC



Capabilities / Services

- Launch induced environment prediction
 - Plume modeling
 - Blast pressure
 - Ignition over pressure (IOP)

- Acoustics
- Structural vibration
- Design GSE to accommodate launch induced environments
 - Dynamics & kinematics
 - Thermal
 - Shock & vibration response
 - Debris and water impact
- RF/ EMI analysis

Accomplishments

- Umbilical designs and testing for Shuttle, X-33, Ares I, and Commercial
 - Delta IV ECS, Atlas V autocouplers

Equipment / Facilities

- Launch Equipment Test Facility
- Machine Shops / Prototype Shops

Computational Tools

- NASA: RAMP, SPF-II, PLIMP, THERM1D
- Commercial: NASTRAN, ADAMS, Fluent, Sinda-Fluint, Thermal Desktop, Matlab, STAAD
- Research: Wyle Pad Acoustics

Contacts

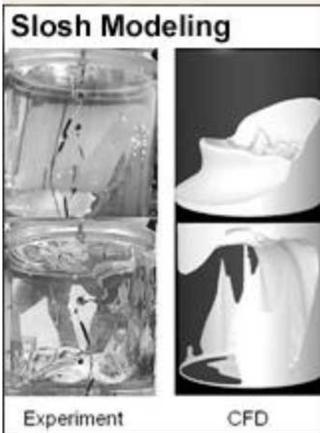
[Joseph Porta](#), 321-867-3748

[George Veaudry](#), 321-867-6106

KSC Technical Capabilities

2.6 Flight Vehicle Design Certification

Independent flight analysis and certification is a core capability for KSC



Capabilities / Services

Mission analysis, and spacecraft integration for NASA payloads

- Trajectory design / flight dynamics
 - Solar illumination analysis
 - Rendezvous, relative motion and re-contact
 - Staging & event timelines
 - Performance trades
 - High-fidelity, 3 & 6 DOF launch vehicle modeling
 - Long-term, high precision orbit propagation
- Structural loads / coupled loads analysis
- Flight software verification/validation
- Integrated thermal analysis
- RF/ EMI analysis
- Contamination control analysis
- Emergency offload analysis
- Image analysis

Accomplishments

- Partnered success of ELV missions on Atlas, Delta and Pegasus, & Taurus
- Microgravity propellant stratification analysis
- 6-DOF micro-gravity slosh testing / CFD correlation
- Advanced Cryogenic Expendable Stage (ACES)
- Cryogenic Orbital Testbed (CRYOTE)

Equipment / Facilities

- Subcontracted services – typical for test verification

Computational Tools

- NASTRAN / ANSYS / NASGRO
- Fluent, Sinda-Fluint, Thermal Desktop, Matlab, STAAD
- MDOF; POST;TAOS:OTIS

Contacts

[Hector Delgado](#), 321-867-9295



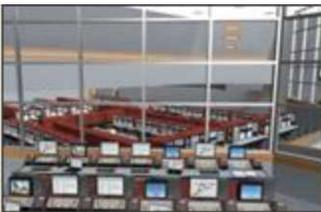
[George Veaudry](#), 321-867-6106

KSC Technical Capabilities

3.0 Command and Control Systems / Services

Expertise in hardware and software development for checkout and launch of spacecraft, payload, and launch vehicles.

System design, simulation, testing, integration, operations, maintenance, sustaining, engineering process, IT security and telemetry monitoring capability.



3.1 Software Development / Processes

- Expertise in open/closed loop software control of end items meeting human rating requirements and software development process for compliance with NASA and industry standards. ([Read more](#))

3.2 Simulation Systems / Model Development

- Modeling and simulations in off-line laboratories environment for Command and Control Models and operational Ground Support Equipment and Facilities for human and expendable launch vehicles. ([Read more](#))

3.3 Software Test Services

- Complete range of subsystem and integrated testing services to support all ongoing software and hardware and operational testing needs. Includes performance and stress testing, porting/upgrade services, and interoperability support to mitigate life-cycle risk. ([Read more](#))

3.4 Operations and Maintenance (O&M) /Sustaining

- Control system O&M / Sustaining to meet diverse processing, configuration management, and system security requirements. ([Read more](#))

3.5 Telemetry Monitoring / Advisory

- Independent monitoring to verify mission data from ground support equipment/rockets/spacecraft and for vehicle and payload troubleshooting. ([Read more](#))

3.6 IT Security Solutions

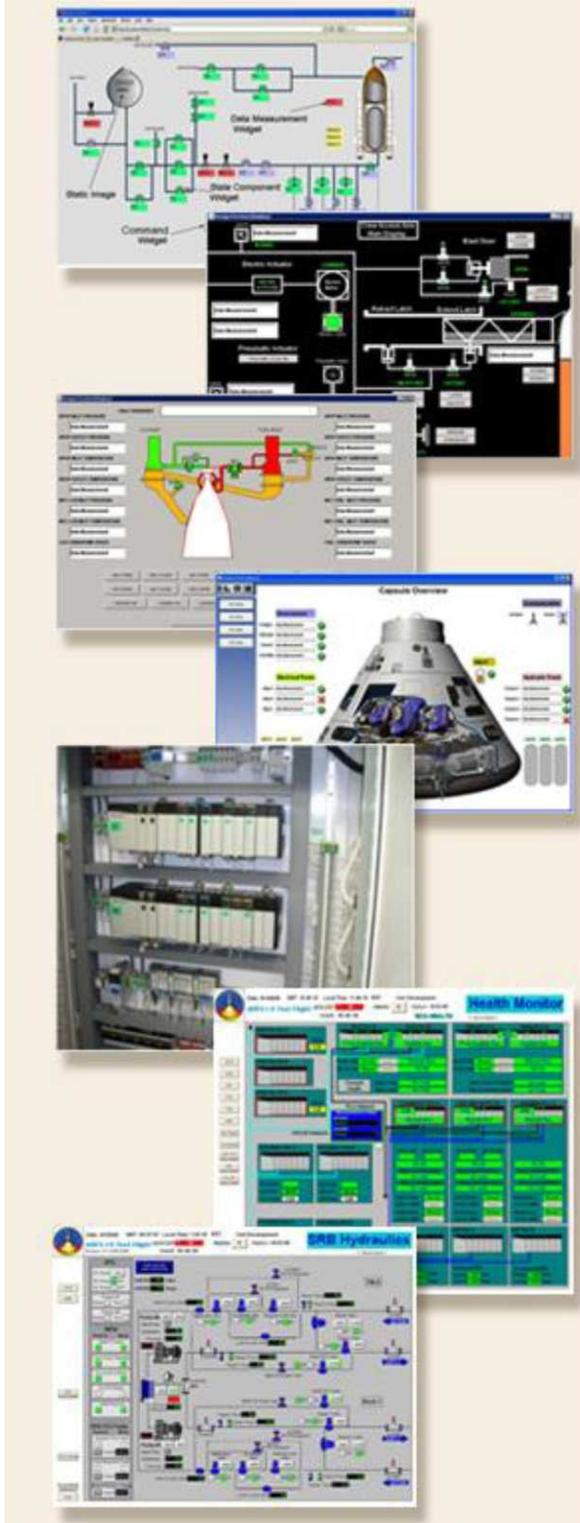
- Architecture, design, development, test, implementation, maintenance, and disposition for compliance with NASA IT Security requirements. ([Read more](#))

KSC Technical Capabilities

3.1 Software Development / Processes

Open/closed loop software control of end items meeting human rating requirements and services in the area of software development process complying with NASA software engineering requirements

Sample Command/Control Displays



Capabilities / Services

- Expertise in the software development and Commercial Off The Shelf (COTS) integration in support of mission critical applications
- Ability to perform interface testing with spacecraft subsystems, integrated vehicle and supporting Ground Support Equipment (GSE) in a variety of configurations and test facilities

- Extensive experience with software process (Capability Maturity Model Integration Level 3 / NASA standards) and engineering lifecycle
- Expertise in customized control systems as well as adapting off the shelf
- Design, Development, Implementation, Certification and Operation for Command and Control of Field and End-Item Controls Systems using Automation/Controls Industry Standardized equipment and applications

Accomplishments

- Software developed, validated, and operationally used for numerous Shuttle subsystems spanning fluids, electrical, avionics, and mechanical disciplines
- Constellation Program Ares I-X Ground Controls System (GCS), used to successfully launch Ares I-X, controlled ~3k end items in 3 facilities
- 21 software languages used to design, develop and deliver the software products used across many hardware platforms and software operating systems, comprising well over 13.6 million lines of code for Shuttle Program
- Command, Monitoring and Data System used to control, monitor, alarm and analyze experiment data
- Software systems supported hundreds of Expendable Launch Vehicles (ELV) launches since the 70's - monitored most ELV launches from both east and west coasts
- Partial Payload Checkout Unit (PPCU) and Test, Control and Monitor System (TCMS) used to perform test and checkout of Space Station hardware/software elements and Shuttle "partial payloads" (e.g.: US Microgravity Payload, Space Radar Lab)

Contacts

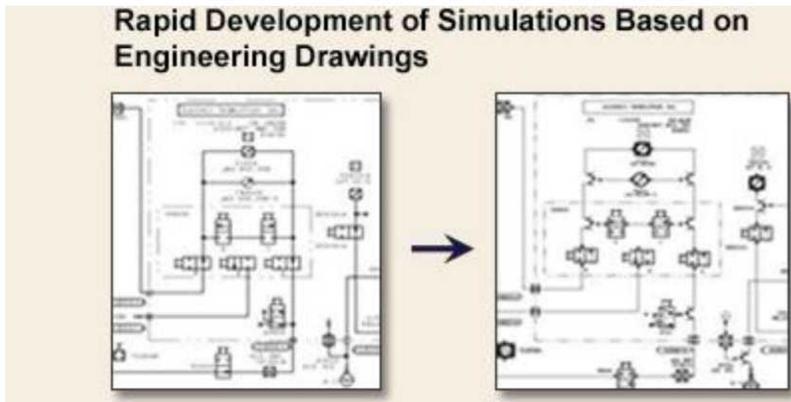
[Khoa Vo](#), 321-861-4282

[George Veaudry](#), 321-867-6106

KSC Technical Capabilities

3.2 Simulation Systems / Model Development

Models and simulation to support design, operations, command and control (C&C) software testing and launch team training



Capabilities / Services

- Expertise for the rapid development of command and control simulations models based on engineering drawings and integration with launch vehicle designs / simulations
- Distributed Integrated Simulations - Distribution of integrated analysis models to support design and operations

Accomplishments

- Integrated training and simulated launch countdowns within Shuttle Program - uncovered numerous problems with application software over lifespan
- Reusable, sharable models being developed for numerous ground systems
- Real-time Simulated Interface (RSI) - provides all hardware and software required to support model execution, external Launch Processing System interfaces, and user interfaces



- Distributed Simulations developed for different Project Elements to engineers across the country at their desk

Contacts

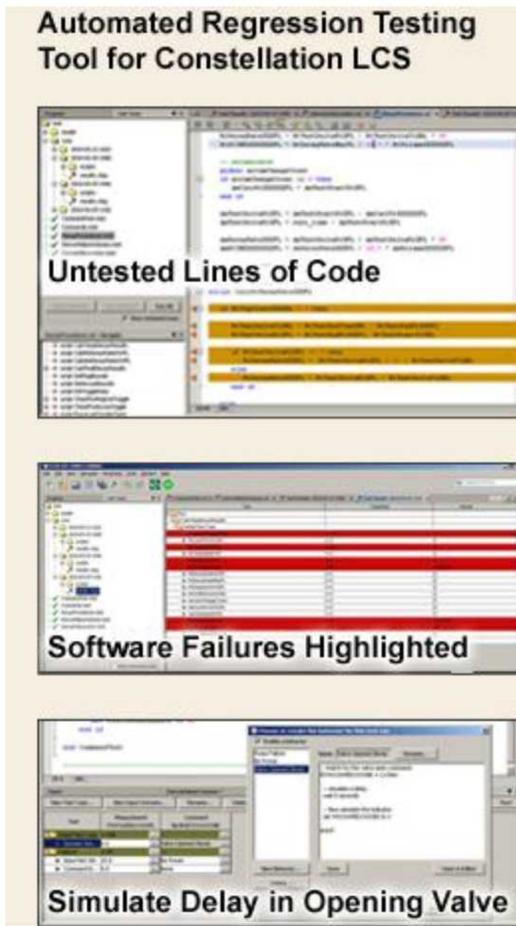
[Nate Taylor](#), 321-861-7277

[Tracey Kickbusch](#), 321-867-2770

KSC Technical Capabilities

3.3 Software Test Services

Provide complete range testing services to support all ongoing software testing needs



Capabilities / Services

- Software testing - unit, integrated, regression, performance, automated, black / white / gray box, code coverage / reporting metrics, dynamic/static, against test stubs / simulations
- Software verification/validation including requirements traceability per NASA standards
- Testing is performed using desk top debug environments, development and validation labs, and controlled hardware test facilities

Accomplishments

- Tens of thousands of unit tests and verification procedures on safety critical software code for both modern and heritage systems

- Developed automated regression testing tool for application software executed on modern launch control system

Equipment / Facilities

- Software & Hardware development environments located in the Space Station Processing Facility

Contacts

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KSC Technical Capabilities

3.4 Operations and Maintenance (O&M) /Sustaining

Proven capability to rapidly test and deploy H/W & S/W solutions

Firing Room 4



Capabilities / Services

- Expertise in the generation and execution of operations & maintenance (O&M) related processes and procedures
- Expertise in preventative maintenance on operational systems
- Expertise in all aspects of configuration management
- Expertise in ensuring hardware availability to support real-time testing through application of structured O&M policies

Accomplishments

- Supported the O&M of the STS Launch Processing System throughout the life of the Program

- Provided support to the ARES I-X Test Launch

Equipment / Facilities

- LCC Firing Rooms
- Central Operations Facility
- Shuttle Support equipment – Shuttle Data Center, Record and Playback Subsystem

Contacts

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KSC Technical Capabilities

3.5 Telemetry Monitoring / Advisory

Telemetry monitoring systems to independently verify mission data from rockets / spacecraft and for vehicle and payload troubleshooting

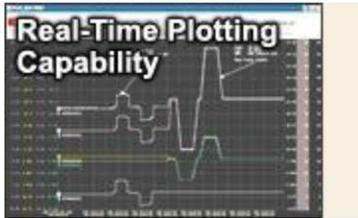


Capabilities / Services

- Real-time plotting and retrieval functions at the Firing Room console or in the office
- Real-time and near real-time troubleshooting tools - data for offsite users
- Translates data into information with capabilities such as data fusion, health and persistent data
- Digital storage and file transfer of analog data
- Real-time or post test bit anomaly detection and measurement scaling
- Data Analysis at the bit level
- 24/7 intelligent, autonomous based data monitoring
- Data acquisition, Engineering Unit conversion and analysis
- Variety of data output methods and report formats

Accomplishments

- Supported 132 Shuttle missions
- Supported Ares I-X demonstration launch
- Supported hundreds of Expendable Launch Vehicles (ELV) launches since the 70's - monitored most ELV launches from both east and west coasts



Contacts

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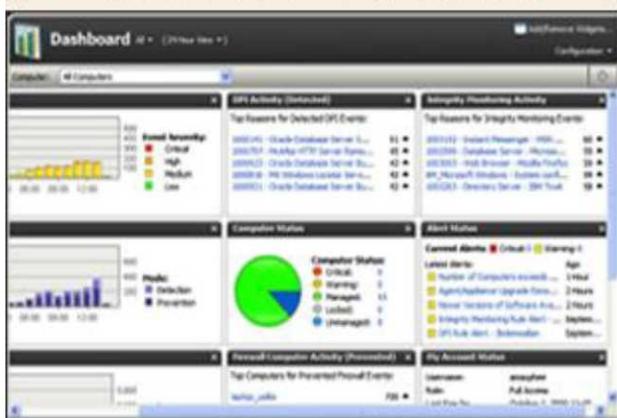
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KSC Technical Capabilities

3.6 IT Security Solutions

Providing overall services including architecture, design, development, test, implementation, maintenance, and disposition for compliance with NASA IT Security requirements

Host Intrusion Detection Prevention Monitoring



Capabilities / Services

Overall Information Security Services

- Asset inventory management
- User authentication
- System configuration compliance
- Security event log monitoring
- Host intrusion detection prevention
- Malicious code protection
- Security policy monitoring
- Security plan maintenance
- Certification & accreditation
- End to end security to protect commercial and NASA assets

Accomplishments

- Development of IT Security for the Launch Control System, Constellation Ground Systems, and Engineering Labs
- Certification & Accreditation of NASA Engineering Labs

- Development of Security Plans, Policies, Procedures for unique and specialized systems
Malicious Code Virus Protection Monitoring



Equipment / Facilities

- SSPF Application Development Set
- LCC Firing Room

Contacts

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<http://kscpartnerships.ksc.nasa.gov/techCap/materialProcesses.htm>

KSC Technical Capabilities

4.0 Materials & Processes

Expertise for materials selection, corrosion control, nondestructive evaluation, custom optics, welding engineering, contamination control, testing & analysis laboratories.

Includes anomaly investigations and launch equipment/component qualifications.



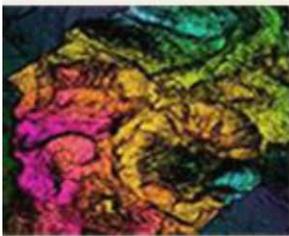
Shearography



Shuttle External Tank



Payload Inspection



Rapid Anomaly Resolution & Testing

4.1 Materials Selection

- M&P evaluation, assessment, and selection for design/development and operations for metals, nonmetals & composite materials. ([Read more](#))

4.2 Corrosion Control

- Corrosion mitigation, research, development and testing to determine material performance in launch and marine environments including the most corrosive test site in North America. ([Read more](#))

4.3 Nondestructive Evaluation (NDE)

- NDE methods including custom solutions including:
 - Visual inspection, magnetic particle, liquid penetrate, radiography (including a large chamber computed tomography (CT), phased array ultrasonics, shearography, eddy current, infrared testing (thermography). ([Read more](#))

4.4 Welding Engineering

- Requirement development, welding procedures and performance qualifications, inspection, and interpretation of standards for a wide-range of welding processes. ([Read more](#))

4.5 Contamination Control

- Surface cleanliness verifications/inspections; sampling, test and analysis; precision cleaning; procedure development (repair, operations & maintenance); and real-time environmental monitoring and mitigation. ([Read more](#))

4.6 M&P Laboratories, Shops, and Testing Facilities

- On-site, rapid turnaround failure analysis; mishap investigation; materials testing; precision dimensional analysis; chemical analysis ; development, fabrication, & testing of components and systems including rapid prototyping. ([Read more](#))

KSC Technical Capabilities

4.1 Materials Selection

Rapid response, onsite, comprehensive failure analysis & materials testing



Capabilities / Services

- Selection for design & manufacturing (metallic/nonmetallic materials, welding, coatings, corrosion control and composites)
- Development of agency & international specifications and standards
- Oxygen compatibility assessment
- Ongoing research in advanced NDE techniques, composites, corrosion coatings, refractory concrete, self healing materials

Accomplishments

- American Welding Society (AWS D17) Chair, Committee on Welding in the Aircraft and Aerospace Industries
 - D17.1 Specification – Fusion Welding for Aerospace
 - D17.2 Specification – Resistance Welding for Aerospace
 - D17.3 Specification – Friction Stir Welding for Aerospace Applications
- Aerospace Materials Engineering Committee (SAE/AMS) Voting Member
- American Society for Testing of Materials (ASTM G4) Voting Member
- ISO Technical Committee 44/Working Group 4, “Welding and Brazing in Aerospace” Designated U.S. Voting Member
- National Association of Corrosion Engineers (NACE) Technical Fellow
- American Society for Nondestructive Testing (ASNT) Level III Certifications
- Materials selection and manufacturing methods to address in-service failures
 - Custom alloy design & casting process for the Crawler Transporter Tread Belt Shoe

Contacts

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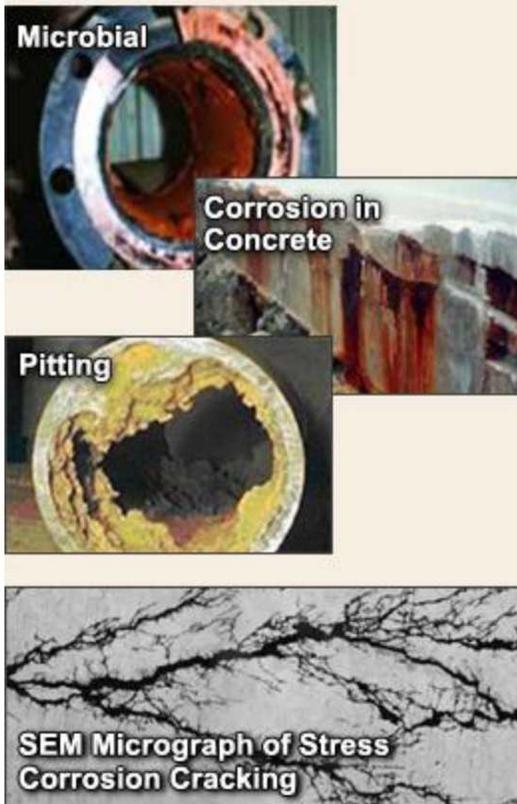
KSC Technical Capabilities

4.2 Corrosion Control

Most corrosive test site in North America



Typical examples of corrosion in launch environment



Capabilities / Services

- Corrosion control prevention, detection & mitigation
- Identification & validation of solutions to corrosion problems
- Accelerated lab & field testing

- Remote tele-monitoring
- Investigate, evaluate, and determine material performance
- Applied research in areas of coatings, refractory and self healing materials

Accomplishments

- NACE Technical Fellow
- 10+ patents
- PhD chemists, corrosion & chemical engineers on staff
- Collaborations with U.S. Military, Department of Transportation, numerous commercial & university affiliates
- Developed proven methodologies to evaluate & test coatings
 - Over 40 years of test data & publications in the fields of corrosion and coatings

Equipment / Facilities

- Beachside Atmospheric Test Facility & Corrosion Laboratory
- Materials Testing Laboratory

Contacts

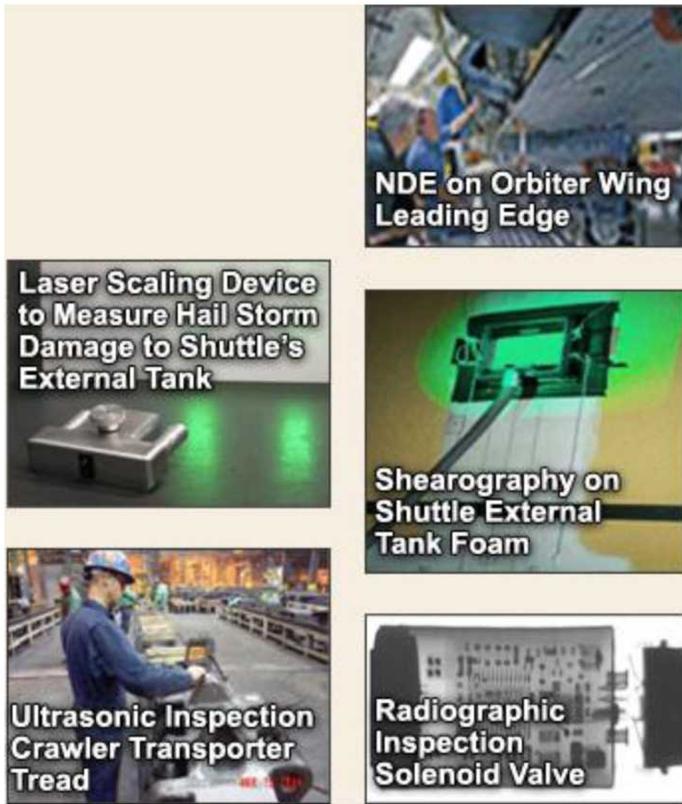
[Louis MacDowell](#), 321-867-4550

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KSC Technical Capabilities

4.3 Nondestructive Evaluation (NDE)

Traditional & novel NDE methods to address custom problems



Capabilities / Services

- ASNT and NASA STD-410 Level I, II, and III certifications
- NDE methods include:
 - visual inspection
 - magnetic particle
 - liquid penetrant
 - radiography
 - phased array ultrasonics
 - shearography
 - eddy current
 - infrared testing (thermography)
 - radiography
 - large chamber CT
 - microfocus X-ray
 - real-time X-ray
 - high energy X-ray

- portable X-ray
- backscatter
- Custom optics solutions

Accomplishments



- Rapid development of advanced NDE methods for:
 - Thermographic inspection of Shuttle wing leading edge reinforced carbon-carbon (RCC) panels in response to Columbia accident
 - Shearography inspection method for external tank insulating foam
- Practical solutions to solve difficult multidiscipline problems including tool development & COTS modification

Contacts

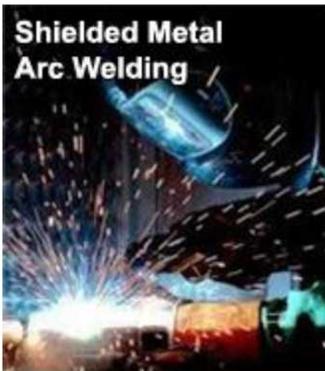
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KSC Technical Capabilities

4.4 Welding Engineering

Design & manufacturing welding requirements development & implementation



Capabilities / Services

- Design & manufacturing requirements development and implementation
- Generate welding procedure specifications for custom applications for multiple methods:
 - SMAW, GMAW, GTAW, FCAW, SAW, FSW, RSW, and RSEW

- Brazing and soldering processes
- Weld inspection requirements and standards application for a range of welding processes: AWS, ASNT, ASM, ASTM and MIL

Accomplishments

- American Welding Society (AWS D17) Chair Committee on Welding in the Aircraft and Aerospace Industries
 - Subcommittee AWS D17K Fusion Welding for Aerospace & AWS D17D Resistance Welding for Aerospace Voting Members
 - Author:
 - * D17.1 Specification – Fusion Welding for Aerospace
 - * D17.2 Specification – Resistance Welding for Aerospace
 - * D17.3 Specification – Friction Stir Welding for Aerospace Applications
- ISO Technical Committee 44/Working Group 4, “Welding and Brazing in Aerospace” Voting Member
- Welding engineering for lifecycle cost savings for Constellation Program:
 - Custom welding procedure developed for mass implementation of new application for AL6XN alloys in a KSC launch environment

Shops & Labs

- Prototype Development Laboratory
- Launch Equipment Test Facility

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KSC Technical Capabilities

4.5 Contamination Control

Ground & on-orbit contamination control



Capabilities / Services

- Environmental requirements, monitoring and procedure development (repair, operations & maintenance)
- Contamination detection & mitigation
 - Surface cleanliness verifications / inspections of systems
 - Precision cleaning

Accomplishments

- On-orbit contamination solutions
- Root cause identification & implemented contamination process to prevent recurrence of on-orbit contamination of the Solar Alpha Rotary Joint (SARJ)
- Over 20 years of environmental monitoring & contamination control services to a wide range of simple to complex payloads for low earth orbit and interplanetary robotic missions. (i.e., Hubble, Galileo, WISE, SDO, CHANDRA, TEDRIS, Magellan)



Equipment / Facilities

Onsite, rapid response labs:

- Failure Analysis & Materials testing labs
- Chemical test & analysis
- Precision Cleaning

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KSC Technical Capabilities

4.6 M&P Laboratories, Shops, and Testing Facilities

Rapid response, onsite, comprehensive failure analysis & testing



Capabilities / Services

- Failure analysis
- Materials testing
- Corrosion control prevention, detection & mitigation
 - Most corrosive test site in North America
- Metrology/precision dimensional analysis (in lab & field)
- Chemical analysis
- Rapid prototyping
- Nondestructive evaluation

Multi-disciplined Staff:

- Metallurgical engineers
- Material science engineers
- Mechanical engineers
- Electrical engineers
- Welding engineers
- Chemical engineers
- Aerospace engineers
- Corrosion engineers
- Physicists

Accomplishments

- Experience with Apollo, Shuttle, Ares, and commercial aerospace
- Collaborate with NTSB, NESC, OIG, Local Law Enforcement, FDLE
- Flight hardware failure analysis
 - Root cause determination of source of on-orbit Solar Alpha Rotary Joint (SARJ) contamination and development of mitigation process resulting in an extra vehicular activity to implement the solution
- Mishap investigations
 - In-flight anomaly root cause analysis
 - Commercial Propane Storage Vessel Explosion

Equipment / Facilities

- Comprehensive, on-site, rapid response failure analysis & testing laboratories

Ongoing Research

- Novel NDE techniques
- Advanced Materials (Cryogenic Insulation, Corrosion, Composites Repair, Refractory Materials)

Contacts

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KSC Technical Capabilities

5.0 Research & Technology Development

Expertise & partnerships in cryogenics, electrostatics, advanced materials, corrosion mitigation, advanced remote habitation service.

Corrosion coatings, dust mitigation, specialized insulation, leak detection and isolation of hazardous commodities, water purification, oxygen production, radiation shielding, biomass production and processing.

5.1 Energy Efficient Insulation, Storage & Distribution of Cryogenic Fluids

- Development, testing, and evaluation of thermal insulation systems and advanced cryogenic systems and components. ([Read more](#))

5.2 Materials for Life Cycle Optimization

- Cutting-edge materials and processes to detect, prevent, and mitigate damage caused by the environment (e.g. corrosion, extreme temperatures, dust) and during operations. ([Read more](#))

5.3 Command, Control, and Monitoring Systems

- Smart command, control, and monitoring of ground and flight systems including health management capability and tele-robotics. ([Read more](#))

5.4 Remote Habitation

- In-Situ Resource Utilization, volatiles extraction, and environmental protection on surfaces beyond earth, including, oxygen, water, and fuel production, excavation/handling, & tele-robotics. ([Read more](#))

5.5 Environmental Mitigation, Biomedical Research, & Green Technologies

- Detection and mitigation technologies for improving the quality of life as well as new green technologies. ([Read more](#))

5.6 Modeling and Simulation

- Modeling and simulation tools including virtual reality environments and design visualization with human factors impacts. ([Read more](#))

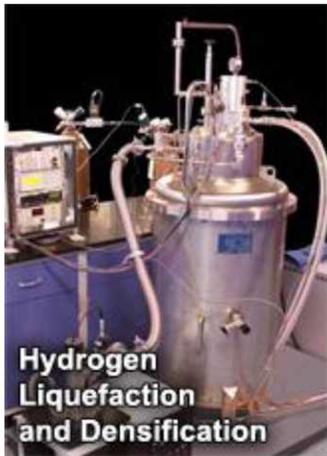
5.7 Life Sciences

- Life support systems and technology for all surfaces (earth and beyond). ([Read more](#))

KSC Technical Capabilities

5.1 Energy Efficient Insulation, Storage & Distribution of Cryogenic Fluids

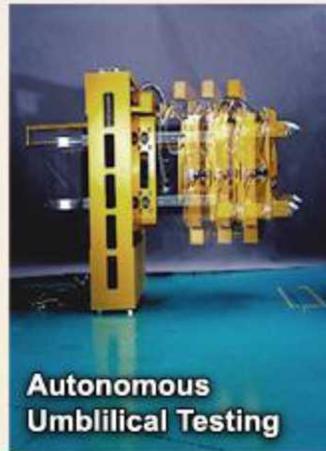
Development, testing, and evaluation of cryogenic systems



Capabilities / Services

Development, testing, and evaluation of thermal insulation systems and advanced cryogenic systems and components

- Thermal Analysis and Modeling
- System Automation and Health Management
- Valves, Pumps, Heat Exchangers, Instrumentation
- Advanced Propellant Servicing - LH2 & LO2 liquefaction, densification and zero boil off
- Cryocooler and refrigeration integration and analysis
- Aerogels for unique ground heat leak applications
- Multi-Layer Insulation systems
- Ground and Flight Applications



Accomplishments

- Developed aerogel-based insulation system for reducing ice formation
- Developed test method for determining cryogenic moisture uptake in foam materials
- Developed a method to eliminate liquid nitrogen formation within Shuttle ET Liquid Hydrogen Intertank and help solve foam loss problems in flight
- Cryogenic Insulation Testing (video)
- Cryogenics Test Laboratory Website
- Rapid Propellant Loading

Equipment / Facilities

- Labs, Shops, and Testing Facilities

Contacts

[James Fesmire](#), 321-867-7557

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KSC Technical Capabilities

5.2 Materials for Life Cycle Optimization

Prevention, detection, and mitigation of material damage



Capabilities / Services

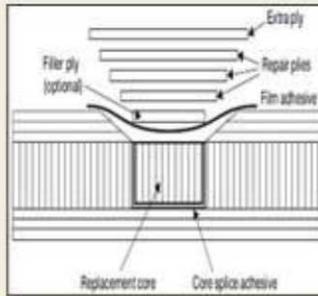
Expertise in the development of cutting-edge materials and processes to prevent, detect, and mitigate damage caused by the environment and during operations.

- Corrosion
- Extreme temperatures and low flammability
 - Enhanced refractory concrete performance
- Static electricity and dust mitigation
- Composite materials repair
- Researching self-healing material processes

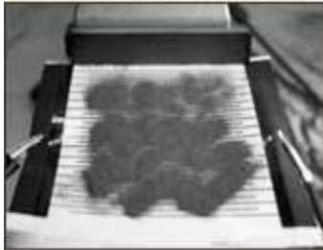
Accomplishments

- Developed microencapsulation technology for corrosion indicators and inhibitors control (patent pending)
- Developed a color indicating hypergolic propellant detection wipe that distinguishes between a fuel and oxidizer for selection of mitigation procedures

- Developed a sensing tape (detects leaks) that changes color upon contact with hydrogen (H₂). H₂ is odorless and colorless; suitable for cryogenic applications



Advanced Composite Repair with NDE Capability



Electrodynamic Dust Removal from a Fabric

- Developed technologies and methods for mitigating dust on critical surfaces such as space suits, solar panels, mechanisms, & Dust Mitigation
- Dust Removal Demonstration (video)

Equipment / Facilities

- Labs, Shops, and Testing Facilities

Contacts

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KSC Technical Capabilities

5.3 Command, Control, and Monitoring Systems

Smart command, control, and monitoring systems



Capabilities / Services

- Range Technologies – Tracking, Surveillance, Communications, and Telemetry
- Autonomous Flight Safety Systems
- Critical Sensors & Transducers (Cryogenic & Hydrogen)
- Hazardous Gas Detection
- Operational Health Management Systems
- Weather Technologies
- Tele-robotics

Accomplishments

- Modeled and demonstrated health management system technology for Ares I-X Thrust Vector Control system
- Sonic Lightning Locator - Developed a real-time system for determining the location of a lightning strike
- Demonstrated Space-Based Range technologies
 - STARS – Space-Based Telemetry and Range Safety system
 - Low Power Transceiver – Allowed mission control to pilot communication on historic GlobalFlyer Flight
- Fault Detection, Isolation, and Recovery for ground operations
- Real-time Online Wiring Diagnostics and Cable Defect Re-Routing System
- Unmanned Aircraft Systems (UAS) Technologies
- Debris Tracking (video)

Equipment / Facilities

- Labs, Shops, and Testing Facilities
- 50MHz Doppler Wind Profiler
- Satellite Tool Kit
- CAD Design tools: including AutoCAD, AutoCAD Electrical, Protel, LabVIEW
- VxWorks
- 14-satellite GPS simulator

Contacts

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KSC Technical Capabilities

5.4 Remote Habitation

Resource utilization and environmental protection beyond earth



Capabilities / Services

Resource utilization and environmental protection on surfaces beyond earth:

- Oxygen, water, and fuel production and waste processing

- Methane regeneration
- Solar energy for oxygen extraction
- Lunar regolith particle separation for further processing
- Regolith excavation and handling
- Habitation and Radiation Shielding
- Dust Mitigation
- Rocket Plume Blast Effects
- Robotics and Tele-Robotics

Accomplishments

- Demonstrated that pilot H₂ reduction system could produce oxygen and water from Mauna Kea (HI) soil
- Designed and completed bench-top optimization experiments to improve lab-scale particle separation system design
- Demonstrated a regolith excavation and handling vehicle with multiple end effector attachments (drilling, excavation, clearing)
- Demonstrated that solar energy can be used for oxygen extraction. The initial solar unit delivered 700-900W of power

Equipment / Facilities

- Labs, Shops, and Testing Facilities

Contacts

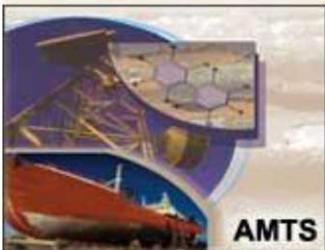
[Bill Larson](#), 321-867-8747

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KSC Technical Capabilities

5.5 Environmental Mitigation, Biomedical Research, & Green Technologies

Technologies to enhance the quality of life



Capabilities / Services

- Field deployment of remediation materials & technologies
- Particle separation methods
- Design, fabrication, and testing of personal protective equipment and breathing apparatus prototypes

- Design and fabrication of emergency medical equipment and communications devices
- Design and implementation of physiological protocols for human testing, both lab based and remotely
- State-of-the-art biological and molecular imaging facilities
- Green Technologies – Alternative Energy Prototypes
 - Hydrogen Power
 - Solar Energy
 - Superconducting Magnetic Energy

Accomplishments

- Environmental Remediation Technologies:
 - EZVI - Designed for the in-situ treatment of dense non-aqueous phase liquids (DNAPLs) and is one of the few methods that can treat the DNAPL source
 - AMTS – Used for extracting and destroying polychlorinated biphenyls, or PCBs, in paint and caulking
- ResQPOD - A noninvasive medical device that quickly and improves circulation in patients suffering cardiac arrest and blood flow to the brain

Equipment / Facilities

- Labs, Shops, and Testing Facilities
- Bio-Imaging Lab

Contacts

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KSC Technical Capabilities

5.6 Modeling and Simulation

Improving safety, efficiency, and effectiveness through modeling and simulation



Capabilities / Services

- Human Centered Engineering of Safety Critical Systems
- Analyze and Evaluate Life Critical System Failure Modes & Effects
- Extend “human factors” into the workings and processes of the human mind
- Human Centered Automation in the context of Safety Critical Systems
- Collaborative Systems Engineering
- Apply advanced interactive system and methods to Safety Critical System controls

- Multi-modal Interfaces, Ubiquitous Computing, Distributed Cognition
- Human Centered Information Flows for Socio-Cognitive Stability

Accomplishments

- For ARES I-X, collected 3D CAD models from several contractors and converted and imported into a visualization environment to simulate processing flow within VAB High Bay 4
- Developed system and mission models and simulations for the Lunar Habitat Demonstration Unit project
- Design Visualization (sample simulations)
 - Orion Operations (video)
 - Orion Recovery (video)

Equipment / Facilities

- Labs, Shops, and Testing Facilities
- Human Factors Tools: Human Builder, Human Task Simulations

Contacts

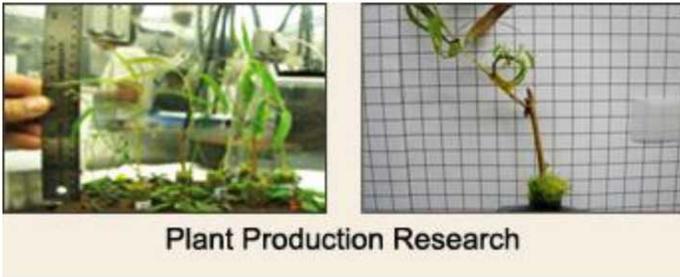
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[Marc Seibert](#), 321-867-3504

KSC Technical Capabilities

5.7 Life Sciences

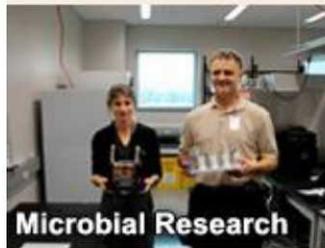
Life support systems for all surfaces (earth and beyond)



Capabilities / Services

Life support systems and technology for all surfaces (earth and beyond)

- Cellular and Microbial Research
- Closed Environment Plant Production Research
 - Lighting
 - Hydroponics and nutrients



- Off-gassing control
- Gravity
- Light intensity and color variation
- Air and water purification
- Solid waste management technologies

Accomplishments

- UV Lighting Research (Lighting Testbed)
 - Evaluating as a candidate for flight water purification system
 - Test and dev of systems with spectral control to effect the mood of the astronauts
 - Test and dev to reduce energy consumption and mass on ISS
- Bacteria Research (video) - To improve the health of astronauts in space
- Plant Research (video) - For nutritional and psychological value on long range missions

- Aerobic Rotational Membrane System (ARMS) – Biological treatment of water in space requiring less mass and energy
- Research Space Bio-converter (RSB) – Testing a composter consisting of a rotating drum waste decomposition
- Command, Monitoring, and Data System – Allows scientists from all over the world to control, monitor, and analyze data for experiments in the SLSL and SSPF via web access

Equipment / Facilities

- Labs, Shops, and Testing Facilities
- Bio-Imaging Lab

Contacts

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KSC Technical Capabilities

6.0 Laboratories, Shops & Test Facilities

6.1 Materials Testing Laboratories

- On-site rapid response failure analysis, mishap investigation, materials testing, chemical analysis, precision measuring, cryogenic testing, NDE, rapid prototyping, & dust mitigation (electrostatics). ([Read more](#))

6.2 Life Cycle Modeling and Simulation and IT Services

- Full lifecycle simulation development including command and control operations, supply chain management, process flows, discrete events and human factors impacts. ([Read more](#))

6.3 Life Sciences & Environmental Laboratories

- Experimentation and field testing on a wide variety of manned systems , controlled environment experiment design, setup, and maintenance , animal care, environmental remediation, ecology. ([Read more](#))

6.4 Electrical Laboratories

- Concept development, prototyping, design, fabrication, testing, trouble shooting for power, monitoring, and control systems specializing in ground to vehicle and payload interfaces. ([Read more](#))

6.5 Launch Equipment Test Facility

- Launch environment test simulation & qualification including Vehicle Motion Simulator, Component Lift-off Simulator, 600 Ton Proof Load Test Fixture, Hold Down Post Test Fixture, cryogenic testing and full-scale umbilical testing. ([Read more](#))

6.6 Developmental Prototype & Fabrication Shops

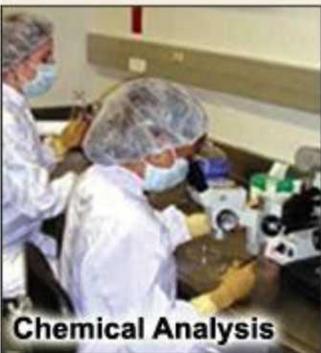
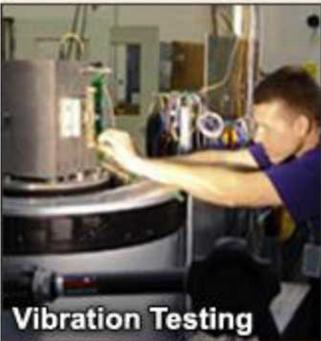
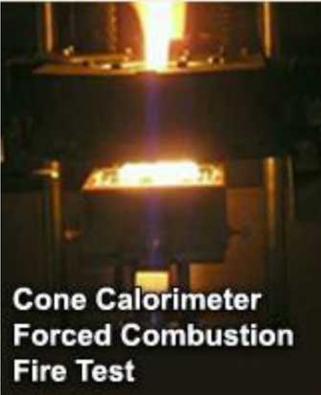
- Rapid mechanical & electrical prototyping; design, development, fabrication & testing of components. ([Read more](#))

<http://kscpartnerships.ksc.nasa.gov/techCap/materialsTest.htm>

KSC Technical Capabilities

6.1 Materials Testing Laboratories

Onsite testing services & rapid anomaly resolution



Capabilities / Services

- Materials Testing
 - Cryogenics
 - Chemical sampling & analysis
 - Corrosion

- Electrostatics
- Tensile, compression, & fatigue
- Vibration
- Thermal vacuum & environmental chamber
- Materials compatibility (oxygen; hypergols; flammability)
- Failure Analysis (Materials, Electrical, & Mechanical)
- Non-Destructive Evaluation
 - Lab, field, & advanced techniques
- Precision measurement/metrology
- Mechanics of materials in a launch pad environment
- Rapid prototype support

Accomplishments

- Experience with Apollo, Shuttle, ISS, Ares, and commercial aerospace
 - Wire Rope Lighting Strike Testing
 - Refractory Concrete Testing
 - Ice Detection Method
- Collaborations with DoD, NTSB, NESC, OIG, Local Law Enforcement, FDLE, Academia

Multi-disciplined Staff

- Metallurgical engineers
- Materials Science engineers
- Mechanical engineers
- Electrical engineers
- Welding engineers
- Chemical engineers
- Chemists
- Fluids engineers
- Aerospace engineers
- Corrosion engineers
- Physicists

Contacts

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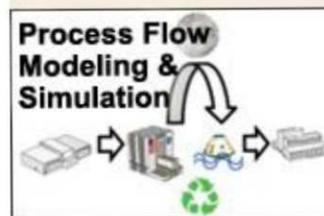
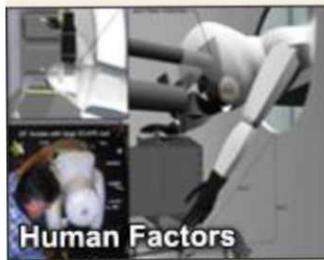
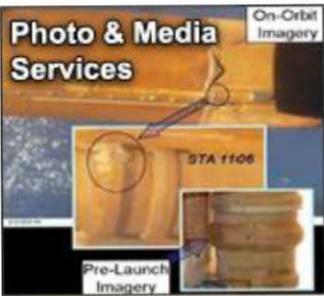
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<http://kscpartnerships.ksc.nasa.gov/techCap/lifeCycleModSim.htm>

KSC Technical Capabilities

6.2 Life Cycle Modeling and Simulation and IT Services

Life-Cycle Modeling and Simulation have been proven to save time and money



Capabilities / Services

- Modeling & simulation – Command & control supply chain management & process flow
- Discrete event simulation
- Design visualization - Operations development, integration, verification, troubleshooting, reverse engineering, & human factors
- Copper / fiber optic cable supply, IT security, photo / media services, operational television, timing and countdown, and audio, video, and data transport to remote locations
- Develop and implement technologies to extend IT services to remote locations; mobile and portable systems

Accomplishments

- Experience with Apollo, Shuttle, ISS, Ares, and commercial aerospace
 - Developed models and simulations to demonstrate process flows in the O&C building for Orion Final Assembly Work
 - Developed models and simulations to improve workflow efficiencies (e.g. work in the VAB)
 - Provided portable and mobile communications infrastructure support for Desert Research and Technology Studies (Desert RATS) in Arizona

Equipment

- Telescience and Internet Systems Lab
- CAD Tools: CATIA, ProE, NX, MicroStation
- Human Factors Tools: Human Builder, Human Task Simulations

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<http://kscpartnerships.ksc.nasa.gov/techCap/lifeScienceEnvLab.htm>

KSC Technical Capabilities

6.3 Life Sciences & Environmental Laboratories

Capabilities / Services

Accomplishments

Equipment

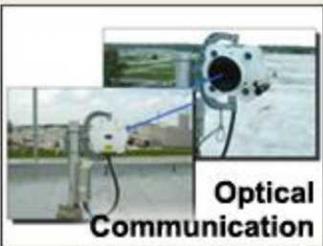
Contacts

<http://kscpartnerships.ksc.nasa.gov/techCap/electricalLab.htm>

KSC Technical Capabilities

6.4 Electrical Laboratories

Advanced electrical systems supporting launch processing



Capabilities / Services

Full life cycle support including concept dev, prototyping, design, troubleshooting, testing, etc. for power, command, monitoring, and control systems:

- Critical sensors & transducers (cryo/hydrogen)

- Hazardous gas detection
- High speed data acquisition
- PLC based control systems
- Range technology (tracking, telemetry, & comm)
- Software - system applications & embedded
- Health management systems
- Electromagnetic interference monitoring & mitigation
- Environmental and qualification testing

Accomplishments

- Frequently enhance COTS equipment to meet launch system requirements
 - For example, current-to-voltage boards into detector electronics U9500 hydrogen leak detector
- Rapid, electrical trouble shooting to solve launch countdown issues
 - Upgraded hardware and software of engine cutoff sensors for increased reliability
- Engineering solutions to unique launch processing problems
 - Developed a laser scaling device for telephoto analysis to assess hailstorm damage; technology currently in use by crime scene investigation industry
 - Developed a low powered transceiver to provide real time cockpit video of Steve Fossett's historic around the world flight aboard Virgin Atlantic's Global Flyer
- Developed and demonstrated technology to detect and locate opens and shorts in powered and unpowered cables and to mitigate these issues

Equipment / Tools

- CAD Design tools: including AutoCAD, AutoCAD Electrical, Protel, LabVIEW
- PLC software tools: including Historian, RS Network, Rockwell RS-Logix, FT View
- VxWorks
- 14-satellite GPS simulator, Satellite Dev Kit

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<http://kscpartnerships.ksc.nasa.gov/techCap/launchEquip.htm>

KSC Technical Capabilities

6.5 Launch Equipment Test Facility

Proven launch environment test simulation / qualification



LV Motion Simulator



TUUA Arm Test



TUUA Arm Test



Rapid Prototype



Capabilities / Services

- Full-scale umbilical and GSE testing with vehicle motion and lift-off simulation
- LN2 and LH2 flow to subject test articles to cryogenic temperatures and pressures that simulate launch processing conditions
- Component testing using LN2, LH2, GN2, GHe, Water, or hydraulic fluid
- Data acquisition up to 352 channels with recording speeds up to 60 million samples per second
- Rapid prototype development and testing
- PLC/Controls development
- Structural testing/proof load testing of lifting hardware, slings, etc, up to 600 tons
- Instrumentation services (fixed & portable)
- Pyrotechnics testing
- Test Engineering

Accomplishments

- X-33 Cryo, & Delta IV ECS Umbilicals
- Multi-program component qual tests
- Centaur rolling beam tests
- ELV payload fairing tests
- Apollo & Shuttle mechanisms /components

Equipment / Facilities

Test Fixtures

- Vehicle motion simulator
- Component lift-off simulator
- 600-ton proof load test fixture
- Hold down post test fixture
- Water flow test loop
- Cryogenic component test area
- Fluids component test bench
- Launch simulation towers
- GSE integration testbed
- Vibration component shaker table

Support Systems

- Control room
- Cryogenic system (LN2 & LH2)
- Pneumatics system (GN2 & GHe)
- Data acquisition system
- Video system (high/low speed/thermal)
- Hazardous gas detection system
- Area warning light system
- Paging & area warning
- Operational audio comm system
- AC / DC power

Development Shops & Labs

- Machine Shop
- Weld Shop
- Pneumatics Shop
- Cable Fabrication & Molding Shop
- Electrical Shop
- Data Acquisition Systems Lab
- LETF High Bay & Mechanical Shop

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KSC Technical Capabilities

6.6 Developmental Prototype & Fabrication Shops

Quick turnaround & troubleshooting tools and test equipment



Capabilities / Services

- Design, fabrication and testing of prototypes, test articles and test support equipment
- Real-time prototypes to facilitate rapid solutions to complex problems
- Consulting for “Design for Manufacturability”
- Research test article and test fixture design and fabrication support

Accomplishments

- Design and manufacturing of specialized tooling, flight hardware and support equipment components for resolution of launch constraints
 - X-33, ISS, Shuttle, and ELV
- Constellation design and manufacture support for prototype hardware, e.g. Orion Crew Module to White Room Interface and Aft Bay Simulator
- Design and fabrication of GSE and flight hardware of Ares I-X, e.g. Stack 5 lifting fixture, numerous sensor brackets
- 1/7 scale Delta IV launch duct for validating over / under-pressure modeling
- Taurus II – Fairing air flow mockup / test

Equipment / Facilities

Shops & Labs

- Prototype Lab
- Machine Shop
- Weld Shop
- Pneumatics Shop
- Cable Fabrication

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